SUPREME COURT OF THE UNITED STATES.

No. 304.

THE AMERICAN WOOD PAPER COMPANY, APPELLANT,

vs.

JACOB D. HEFT, S. A. RUDOLPH, AND JOHN W. DIXON.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE EASTERN DISTRICT OF PENNSYLVANIA.

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1 *Docket entries.—April session*, 1865.

THE AMERICAN WOOD PAPER COMPANY, a corporation created by the legislature of the State of Rhode Island, a citizen of the State of Rhode Island,
vs.
JACOB D. HEFT, S. A. RUDOLPH, AND JOHN Dixon, co-partners, transacting business under the firm of J. D. Heft & Company, citizens of the State of Pennsylvania. } 20.

H. E. Wallace, J. A. Jenckes; Geo. Harding.

1865.

August 29. Bill filed; subpœna issued, returnable on the first Monday of October next.

October 2. Geo. Harding, esquire, appears for defendants.

" " Subpœna returned. Service accepted.

" 14. Demurrer filed.

" 26. Demurrer overruled, and ordered to stand as a plea or answer, if it may in either respect avail the defendants.

1866.

March 10. Answer filed.

April 19. Replication filed.

1867.

March 13. Kenneth G. White, esquire, appointed special examiner to take testimony in the city of New York.

May 18. Depositions of C. Jacobs, delivered in open court. Opened and filed.

2 October 1. Depositions of witnesses and exhibits filed.

" 5. Supplemental bill filed. Subpœna ex't.

" 7. Monday, October 28, 1867, peremptorily fixed for the hearing of this case.

" 16. Amendment to answer filed.

" 29. Replication to answer to supplemental bill filed. Answer to supplemental bill filed.

November 22. Opinion delivered by Mr. Justice Grier, and filed; opinion delivered by Judge Cadwalader, and filed.

And now, to wit, on the twenty-second day of November, A. D. 1867, this cause came on to be heard at this term, on bill, answer, and proofs. After consideration, it is ordered, adjudged, and decreed that the bill be dismissed. Whereupon an appeal is prayed by complainants, which is allowed.

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5 Pleas before the honorable the judges of the Circuit Court of the United States for the eastern district of Pennsylvania, in the third circuit, of April session, 1865. No. 20.

It is thus contained : Be it remembered that heretofore, to wit, on the 29th day of August, A. D. eighteen hundred and sixty-five, the American Wood Paper Company, by their solicitors, Henry E. Wallace, and Thomas A. Jenckes, esquires, filed of record in the said court their bill of complaint against Jacob D. Heft, S. A. Rudolph, and John Dixon, co-partners, transacting business under the firm of J. D. Heft & Company, in the words and of the terms following, to wit:

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9 In the Circuit Court of the United States for the eastern district of Pennsylvania.

THE AMERICAN WOOD PAPER COMPANY
vs.
J. A. HEFT *et al.* } In equity.

To the judges of the Circuit Court of the United States for the eastern district of Pennsylvania:

The American Wood Paper Company, a corporation created by the legislature of the State of Rhode Island, a citizen of the State of Rhode Island, bring this their bill of complaint against Jacob D. Heft, S. A. Rudolph, and John Dixon, all of the city and county of Philadelphia, in the eastern district of Pennsylvania, and citizens of the State of Pennsylvania, co-partners, transacting business under the firm of J. D. Heft & Company, in said district.

10 And thereupon your orators complain and say, on information and belief, that heretofore and before the 19th day of August, A. D. 1853, one Charles Watt and one Hugh Burgess, of London, England, were the original and first inventors or discoverers of a new and useful improvement in the manufacture of paper from wood; that being such inventors, the said Watt and Burgess duly made application, in writing, to the Commissioner of Patents of the United States, for the granting of letters patent for said improvement, and duly swore to the specification for that purpose; that the said improvement was not, at the time of said application, in public use or on sale, with the consent or allowance of the said Watt and Burgess, as the inventors or discoverers thereof, contrary to the provisions of the statutes of the United States in such case made and provided, and was not known or used by others anterior to the invention or discovery thereof by the said Watt and Burgess; that the said Watt and Burgess duly complied, in all respects, with all the necessary conditions and requisitions of the statutes of the United States in such case made and provided, prior to the granting of the letters patent hereinafter mentioned; that on the 18th day of July, 1854, letters patent of the United States, bearing date on said last-named day, were issued to the said Watt and Burgess according to law, whereby there was granted to them, their heirs, administrators, or assigns, for the term of fourteen years, from the 19th day of

August, 1853, the full and exclusive right and liberty of making, constructing, using, and vending to others, to be used, the said improvement, a description whereof was given in the words of the said Watt and Burgess in a schedule, which was annexed to the said letters patent, and was made a part of the same; that the said letters patent were issued in the name of the United States of America, and were sealed with the seal of the Patent Office of the United States, and were signed by the Secretary of the Interior of the United States, and were countersigned by the Commissioner of Patents, and were issued and deliverad to the said Watt and Burgess.

And that before the said letters patent were issued to them as aforesaid, the said Watt and Burgess duly made affirmation,
11 before a person authorized by law to administer oaths, that they did verily believe that they were the original and first inventors or discoverers of the said improvement; that the same had not, to the best of their knowledge and belief, been previously known or used; and that they were subjects of the Queen of Great Britain; and that the said Watt and Burgess also paid into the treasury of the United States the sum of five hundred dollars.

And your orators in like manner further aver, that afterwards the said Charles Watt and said Hugh Burgess, for valuable considerations paid them by one Frederic B. Houghton, did, by a certain instrument in writing by them signed and sealed, bearing date the 22d day of November, A. D. 1854, assign, sell, convey, and set over to said Frederic B. Houghton, the right, title, and interest of the said Watt and Burgess in said letters patent, and the invention thereby secured, for, to, and in the United States of America, for and during the full term for which said letters patent were granted, which said assignment was duly recorded in the Patent Office of the United States, on the day of , A. D. , as by said assignment, or a duly authenticated copy thereof, will fully and at large appear.

And your orators, in like manner, further aver, that the said Frederic B. Houghton did, for a valuable consideration paid by one William F. Ladd and one Morris L. Keen, by a certain instrument in writing by him signed and sealed, bearing date the 20th day of March, A. D. 1855, assign, sell, convey, and set over to the said William F. Ladd and the said Morris L. Keen, the right, title, and interest of the said Houghton in said letters patent, and the invention thereby secured, for, to, and in the United States of America, for and during the full term for which said letters patent were granted, which said assignment was duly recorded in the Patent Office of the United States, on the day of , A. D. , as by said assignment, or a duly authenticated copy thereof, will fully and at large appear.

And your orators, in like manner, further aver, that after the said 19th day of August, 1853, the said William F. Ladd and Morris L. Keen did, on account of a defective specification, duly and in
12 accordance with the statute in such case made and provided, surrender the said patent for the purpose of having the said defective specification corrected, and of having, upon an amended

specification, letters patent issued therefor; and that the said Ladd and Keen also paid on said surrender the further duty of fifteen dollars, as by law required; and thereupon, and on the fifth day of October, A. D. 1858, a new patent, bearing date the day and year last aforesaid, was duly issued to the said William F. Ladd and Morris L. Keen, their heirs, administrators, or assigns, on a corrected specification by the said Ladd and Keen duly made and duly filed, for an improvement in the manufacture of paper from wood, for the residue of the unexpired term of said original letters patent, that is to say, for the term of fourteen years from the aforesaid 19th day of August, A. D. 1853.

And your orators, in like manner, further aver, that after the said fifth day of October, A. D. 1858, the said Ladd and Keen did, on account of a defective specification, duly and in accordance with the statute in such case made and provided, surrender the last aforesaid reissued patent for the purpose of having the said defective specification corrected, and the inventions or discoveries therein described separated, and two separate letters patent issued therefor, and that the said Ladd and Keen also paid on such surrender the further duty of thirty dollars, as by law required; and thereupon, and on the seventh day of April, A. D. 1862, two new patents, bearing date the day and year last aforesaid, were duly issued to the said Ladd and Keen, their heirs, administrators, or assigns, on two corrected specifications by the said Ladd and Keen duly made and duly filed, one for the improved process of treating wood and other vegetable substances in the manufacture of paper from pulp, and the other for an improved pulp from wood or other vegetable substances for the manufacture of paper, each of which said last named letters patent was issued for the residue of the then unexpired term of said original letters patent, that is to say, for the term of fourteen years from the said 19th day of August, A. D. 1855.

And your orators further aver, that copies of said letters patent, so as aforesaid reissued to said Ladd and Keen, and of the
13 schedules thereto annexed, are hereto annexed, marked respectively A and B, and your orators pray that the same may be taken as part of this bill. And your orators aver, that the last aforesaid letters patent, so reissued, together with the said corrected specifications have the same effect and operation in law as though the same had been originally filed in such corrected form before the issuing of the said original patent, and that said letters patent, so reissued as aforesaid, have the same effect in law as though they had been originally issued for the term of fourteen years from the said 19th day of August, A. D. 1853.

And your orators further aver, of their own knowledge, that afterwards the said Ladd and Keen, for valuable considerations paid them by Benjamin Buffum, trustee to the American Wood Paper Company, did, by a certain instrument in writing, by them signed and sealed, bearing date the 18th day of May, A. D. 1863, bargain, sell, assign, transfer, and convey unto the said Benjamin Buffum, trustee as aforesaid, and to the said American Wood Paper Company, their succes-

sors and assigns, all the right, title, and interest of the said Ladd and Keen in said original letters patent and the letters patent reissued in the patent April 7th, 1863, as aforesaid, and the invention therein described, for, to, and in the United States of America, for and during the full term for which said letters patent and the said reissues thereof, are or may be granted, which said assignment was duly recorded in the Patent Office of the United States, on the 23d day of October, A. D. 1863, in Liber D 7, page 113 of Transfers of Patents, as by said assignment, or a duly authenticated copy thereof and the certificate of the recording thereof, ready in court to be produced, a copy of which is hereto annexed, marked C, will fully and at large appear.

And your orators further aver, that the said Benjamin Buffum, by instrument in writing, duly executed and recorded in the Patent Office, did on the 13th day of June, A. D. 1865, assign and convey to your orators all his interest in the said letters patent and the invention therein named, a copy of which instrument is hereto annexed and made a part of this bill, marked D.

14 And your orators aver, that by virtue of the hereinbefore recited premises, your orators became and are possessed of and vested with the sole aforesaid exclusive right, during the period aforesaid, to use the invention of the said Watt and Burgess, as described and set forth in the last aforesaid two reissued patents, within the whole of the United States, and have, from the day of the date of the said last-mentioned assignment to said Benjamin Buffum, trustee to the American Wood Paper Company, continued to be and now are the sole and exclusive owners of said sole and exclusive right to said invention and thing patented within the whole of the United States.

And your orators further complain and say, upon information and belief, that heretofore and before the seventh day of August, A. D. 1854, and Maria Amédeé Charles Mellier, of Paris, France, was the original and first inventor or discoverer of a new and useful improvement in making paper pulp; that being such inventor, the said Mellier duly made application in writing to the Commissioner of Patents of the United States for the granting of letters patent for said improvement, and duly swore to the specification for that purpose ; that the said improvement was not, at the time of said application, in public use or on sale, with the consent or allowance of said Mellier as the inventor or discoverer thereof, contrary to the provisions of the statutes of the United States in such case made and provided, and was not known or used by others anterior to the invention or discovery thereof by said Mellier ; that the said Mellier duly complied in all respects with all the necessary conditions and requisitions of the statutes of the United States in such case made and provided, prior to the granting of the letters patent hereinafter mentioned ; that on the twenty-sixth day of May, A. D. 1857, letters patent of the United States, bearing date on said last named day, were issued to the said Marie Amédeé Charles Mellier, according to law, whereby there was granted to him, his heirs, administrators, or assigns, for the term of four-

teen years from the seventh day of August, A. D. 1864, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said improvement, a description whereof was given in the words of the said Mellier, in a schedule which was annexed to the said letters patent, and was made a part of the same; that the said letters patent were issued in the name of the United States of America, and were sealed with the seal of the Patent Office of the United States, and were signed by the Secretary of the Interior of the United States, and were countersigned by the Commissioner of Patents, and were issued and delivered to the said Mellier.

And that before the said letters patent were issued to him as aforesaid, the said Mellier duly made oath before a person authorized by law to administer oaths, that he did verily believe that he was the original and first inventor or discoverer of the said improvement; that the same had not to the best of his knowledge and belief, been previously known or used, and that he was a citizen of France; and the said Mellier also paid into the Treasury of the United States the sum of three hundred dollars.

And your orators further aver, that a copy of said letters patent, so as aforesaid issued to said Mellier, and of the schedule thereto annexed, are hereto annexed marked "E," and your orators pray that the same may be taken as part of this bill.

And your orators further aver, upon like knowledge, that afterwards the said Mellier, by his attorney, Victor Beaumont, thereunto duly authorized and empowered by an instrument in writing by the said Mellier duly executed, ready in court to be produced, a copy of which is hereto annexed marked F, for good and valuable considerations paid him by one Coe S. Buchanan, of the city, county, and State of New York, did, by a certain instrument in writing by the said Mellier, by his attorney the said Victor Beaumont, duly signed and sealed, and bearing date the 19th day of June, A. D. 1857, sell, assign and set over unto the said Coe S. Buchanan, all his rights, title and interest in the said invention, as secured to him by the said patent, for, to, and in the United States of America and its Territories, the same to be held and enjoyed by the said Coe S. Buchanan, for his own use and behoof, and for the use and behoof of his legal representatives, to the full end of the term for which said letters patent were or might be granted, which said assignment was duly recorded in the Patent Office of the United States, in Book M, 4, page 98 of Transfers of Patents, on the 25th day of June, 1857, as by said assignment, or a duly authenticated copy thereof, and the certificate of recording thereof, ready in court to be produced, a copy of which is hereto annexed, marked "G," will fully and at large appear.

And your orators further aver, upon information and belief, that about the day of , A. D. 18 , the said Coe S. Buchanan being then the owner of the title to said Mellier patent, and of the invention therein described, instituted a suit in equity in the Circuit Court of the United States for the Northern District of

New York, against one Gardner Howland and one Joseph B. Palser, and in the bill filed in said cause set out the said Mellier patent as aforesaid, and his title thereto, and to the invention therein described for an improvement in the manufacture of paper, and alleging an infringement thereof by the said Howlan and Palser, an praying an injunction and account against the said Howland and Palser. To which bill of complaint the said Howland and Palser filed their answer, denying the validity of the said letters patent, and setting up that some other persons than said Mellier were the inventors of the things patented to him by said letters patent; and that said Mellier and said Buchanan, as his assignee, had no title by reason thereof in and to his said alleged invention; and also denied the allegation of the infringement of said letters patent; and issue being joined thereon, and the proofs in said cause being taken at great length, the cause was brought to final hearing on its merits, and was argued by counsel at the Term of the Circuit Court of the United States for the Northern District of New York, in the year before Mr. Justice Nelson and Judge Hall; and was, by them, held under advisement until the Term of said court then next following, when the judgment of the court was pronounced and an opinion delivered by his Honor Judge Hall, which was concurred in by Mr. Justice Nelson.

That the said court then and there decided that the said letters patent were valid in law, and that the said Mellier was the first and original inventor of the improvements described in his said specification.

17 And that the said defendants, Howland and Palser, infringed upon said letters patent by the wrongful use of said invention.

And that a decree to that effect was thereupon entered by said court, as by reference to the records of said court, and particularly to said opinion and decree, a copy of which is hereto annexed, marked "H," will more fully appear.

And your orators further aver, of their own knowledge, that afterwards the said Coe S. Buchanan, for valuable considerations paid him by Benjamin Buffum, trustee to the American Wood Paper Company, did, by a certain instrument in writing by him signed and sealed, bearing date the 14th day of October, A. D. 1863, bargain, sell, assign, transfer, and convey unto the said Benjamin Buffum, trustee as aforesaid, and to the said American Wood Paper Company, their successors and assigns, all the right, title, and interest of the said Buchanan in said letters patent, and in and to the invention therein described, being the entire title therein and thereto for and during the period from the date of said letters patent till the expiration of the term for which said letters patent were originally granted, and for such other terms or periods as said letters patent may be renewed or extended, which said assignment was duly recorded in the patent Office of the United States, on the 23d day of October, A. D. 1863, in Liber, D. 7, page 118, of Transfers of Patents, as by said assignment, or a duly authenticated copy thereof, and the certificate of recording thereof,

read in court to be produced, a copy of which is hereto annexed, marked "I," will fully and at large appear.

And your orators aver, that by virtue of the hereinbefore recited premises your orators became and were possessed of, and vested with, the sole aforesaid exclusive right, during the period aforesaid, to use the invention of the said Charles Mellier, as described and set forth in the last aforesaid patent, within the whole of the United States, and have, from the day of the date of the said last mentioned assignment to said Benjamin Buffum, trustee to the American Wood Paper Company, continued to be, and now are, the sole and exclusive owners of said sole and exclusive right to said invention, and thing patented, within the whole of the United States.

18 And they further aver, that the said Benjamin Buffum, by his instrument of assignment, bearing date the 16th day of June, 1865, a copy of which is hereto annexed, marked K, confirmed to your orators their title as aforesaid.

And your orators further aver, that since said 14th day of October, A. D. 1863, they became, so as aforesaid, vested with said sole and exclusive rights to the said patents above named, and that they have continued to enjoy the same, and each thereof, in the manufacture of paper from wood, and in the manufacture of paper pulp from wood, and other vegetable substances, except as said rights have been infringed upon by the defendants and others, and have derived great profit from the use of said rights.

19 And your orators further aver, that heretofore and before the 13th day of September, A. D. 1859, one Morris L. Keen, of Royer's Ford, Pennsylvania, a citizen of the United States, was the original and first inventor of a new and useful improvement in boilers for making paper pulp from wood; that being such inventor the said Keen duly made application in writing to the Commissioner of Patents of the United States for the granting of letters patent for said improvement, and duly swore to the specification for that purpose; that the said improvment was not, at the time of the said application, in public use or on sale with the consent and allowance of the said Keen, of the inventor or discoverer thereof, contrary to the provisions of the statutes of the United States in such cases made and provided, and was not known or used by others anterior to the invention and discovery thereof by the said Keen; that the said Keen duly complied in all respects with all the necessary conditions and requisitions of the Statutes of the United States in such case made and provided, prior to the granting of the letters patent hereinafter mentioned; that on the 13th day of September, A. D. 1859, letters patent of the United States, bearing date on said last-named day, were issued to the said Keen according to law, whereby there was granted to him, his heirs, administrators, or assigns, for the term of fourteen years from the said 13th day of September, 1859, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said improvement, a description whereof was given in the words of the said Keen, in a schedule which was annexed to the said letters patent, and was made a part of

the same; that the said letters patent were issued in the name of the United States of America, and were sealed with the seal of the Patent Office of the United States, and were signed by the Secretary of the Interior of the United States, and were countersigned by the Acting Commissioner of Patents, and were issued and delivered to the said Keen. And that before the said letters patent were issued to him as aforesaid, the said Keen duly made oath before a person authorized by law to administer oaths, that he did verily believe that he was the original and first inventor or discoverer
20 of the said improvement; that he did not know or believe that the same was ever before known or used, and that he was a citizen of the United States; and the said Keen also paid into the Treasury of the United States the sum of thirty dollars.

And your orators further aver, that a copy of said letters patent; so as aforesaid issued to said Keen, and of the schedule thereto annexed, is hereto annexed, marked L, and your orators pray that the same be taken as part of this bill.

And your orators in like manner further aver, that afterwards the said Morris L. Keen, for a valuable consideration paid him by Benjamin Buffum, trustee for the American Wood Paper Company, did by a certain instrument in writing, by him signed and sealed, bearing date the 18th day of May, A. D. 1863, grant, bargain and sell to said Buffum, trustee, and to said American Wood Paper Company, an absolute and exclusive license to use said invention within and throughout the United States of America, for the full term for which said letters patent were granted, and during any extension or renewal thereof, which said assignment was duly recorded in the Patent Office of the United States, on the 23d of October, 1863, in Liber D 7, page 111, of the Transfers of Patents, as by said assignment or a duly authenticated copy thereof, and the certificate of the recording thereof ready in Court to be produced, a copy of which is hereto annexed, marked M, will fully and at large appear.

And your orators aver that by virtue of the hereinbefore recited premises, your orators became and are possessed of and vested with, the sole aforesaid exclusive right, during the period aforesaid, to make, construct, use, sell and vend to others the right to make and use the said invention of said Keen, as described and set forth in said patent, within the whole of the United States, and had from the day of the date of said last mentioned assignment to them hitherto, continued to be, and now are, the sole and exclusive owners of said sole and exclusive right to said invention and thing patented within the whole of the United States, and are entitled to be protected in the enjoyment of the same.

And your orators further aver, that heretofore and before
21 the 16th day of June, A. D. 1863, the said Morris L. Keen, of Royer's Ford, Pennsylvania, a citizen of the United States, was the inventor of a new and useful improved boiler for making paper pulp; that being such inventor the said Keen duly made application in writing to the Commissioner of Patents of the United States for the granting of letters patent for said improvement, and duly swore

to the specification for that purpose; that the said improvement was not, at the time of the said application, in public use or on sale with the consent and allowance of the said Keen as the inventor or discoverer thereof, contrary to the provisions of the statutes of the United States in such case made and provided, and was not known or used by others anterior to the invention or discovery thereof by the said Keen; that the said Keen duly complied in all respects with all the necessary conditions and requisitions of the statutes of the United States in such case made and provided, prior to the granting of the letters patent hereinafter mentioned; that on the 16th day of June, A. D. 1863, letters patent of the United States, bearing date on said last named day, were issued to the said Keen according to law, whereby there was granted to him, his heirs, administrators, or assigns, for the term of fourteen years from the said 16th day of June, 1863, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said invention, a description whereof was given in the words of the said Keen in a schedule which was annexed to the said letters patent, and was made a part of the same; that the said letters patent were issued in the name of the United States of America, and were sealed with the seal of the Patent Office of the United States, and were signed by the Acting Secretary of the Interior of the United States, and were countersigned by the Commissioner of Patents, and were issued and delivered to the said Keen.

And that before the said letters patent were issued to him as aforesaid, the said Keen duly made oath, before a person authorized by law to administer oaths, that he did verily believe that he was the original and first inventor or discoverer of the said improvement; that he did not know or believe that the same was ever before known or used; and that he was a citizen of the United States; and
22 the said Keen also paid into the Treasury of the United States the sum of thirty-five dollars.

And your orators further aver, that a copy of said letters patent, so as aforesaid issued to said Keen, and of the schedule thereto annexed, is hereto annexed, marked N, and your orators pray that the same may be taken as a part of this bill.

And your orators further aver, that the said patent of June 16th, 1863, was for an improvement on the invention described and included in the patent of Sept. 13th, 1859; and that the above described license of May 18th, 1863, covered said patent of June 16th, 1863, and gave your orators the right to use said invention as fully and competely as it did the right to use said invention, patented Sept. 13th, 1859.

And your orators further aver, that the said Benjamin Buffum, by his instrument of assignment, bearing date the 16th day of June, 1865, a copy of which is hereto annexed, marked O, confirmed to your orators their title as aforesaid.

And your orators in like manner further aver, that afterwards the said Morris L. Keen, for a valuable consideration paid him by the American Wood Paper Company, did by a certain instrument in

writing, or agreement, entered into by and between him and said company, and by them signed and sealed, bearing date the eleventh day of July, A. D. 1865, assign and convey unto the said American Wood Paper Company, all his right, title, and interest in and to said letters patent of Sept. 13th, 1859, or by said assignment, a copy of which is hereto annexed, marked P, will fully and at large appear.

23 And your orators further show, upon information and belief, that ever since the 18th day of April, A. D. 1863, the defendants, well knowing the premises, and the rights and privileges secured to your orators by the said several letters patent, aforesaid acquired, by the transfers hereinbefore averred and set forth, did contrive to injure your orators, and to defraud them of their profits, benefits and advantages which might and otherwise would have accrued to them at said Philadelphia, and within the Eastern District of Pennsylvania, and without the license and permission of your orators, since the day of have unlawfully and wrongfully monufaetured and sold large quantities of paper and paper pulp, manufactured in accordance with the descriptions set forth, and by means of the processes and machinery described in the specifications annexed to said letters patent, or some one or more of them, and have manufactured and sold, or used, or vended to others to be used, large quantities of the new manufacture, called paper pulp, manufactured by chemical process, as described in the specifications of the said reissued No. 1,448 of the Watt and Burgess Patent, and are now unlawfully and wrongfully manufacturing and using, or vending to others to be used, large quantities of paper and paper pulp, manufactured in accordance with the descriptions set forth, and by means of the processes and machinery described in the specifications annexed to said letters patent or some one or more of them, and are now manufacturing and selling, or using and vending to others to be used, large quantities of the new manufacture, called paper pulp, manufactured by chemical process as described in the specification of the said reissue, No. 1,448 of the Watt and Burgess Patent, and that said paper and paper pulp so manufactured and sold or used by said defendants, is manufactured by the use of the machinery and processes described in the foregoing patents, used in combination with each other, or in a combination of some two or more of them. But what quantity of paper and paper pulp, manufactured according to said processes or some one of them, has been manufac-

24 tured or sold or caused to be sold by said defendant, or what quantity of said new manufacture of paper pulp has been manufactured or used, or sold to others to be used by said defendant, your orators do not know and cannot state; but upon information and belief, your orators aver that they have sold to others to be used, and have manufactured and used large quantities of the same, and are now selling to others to be used, and manufacturing and using large quantities of the same; and that they have derived and received, and still deriving and receiving from such sale, great gains and profits, but to what amount your orators are ignorant, and cannot

set forth, but your orators believe the same to be of the full sum of fifty thousand dollars, and so charge the fact to be, and pray that the defendant may be required to make a disclosure of all such gains and profits.

And your orators in like manner aver, that the defendant continued to manufacture and sell said paper and paper pulp, and said new manufacture of paper pulp, and the use thereof, as aforesaid, though warned and requested to desist from said manufacture, sale and use, or to pay to your orators the said gains and profits, by means whereof the defendants have greatly injured, and are still greatly injuring your orators, and have deprived and have still depriving your orators from receiving the gains and profits from the exclusive right to use the inventions and improvements claimed in the said reissued letters patent, and other letters patent as aforesaid, which your orators otherwise, and but for said wrongful acts of the defendants, would have obtained and received.

And your orators pray that the said defendants may be compelled, by a decree of this court, to account for and to pay over to your orators all such gains and profits as have accrued or arisen to, or been earned or received by said defendant, and all such gains and profits as have been received, or to which they may be entitled by reason of such sale by them of paper pulp manufactured from wood and other vegetable substances, and of paper manufactured from wood, in accordance with the specifications of the above-named letters patent and in infringement thereof, and all such gains and profits
25 as your orators would have received but for the unlawful acts and doings of the said defendant ; and that the said defendants, their attorneys, solicitors, servants, agents, and workmen, may be perpetually enjoined and restrained by the decree and injunction of this Court, from directly or indirectly making, or causing to be made, or using, or causing to be used, or vending to others to be used in any manner, any paper pulp manufactured from wood or other vegetable substances, or any paper manufactured from wood, substantially as described in any or all of the above named patents; namely, the two reissued patents reissued to Ladd & Keen, April 7th, 1863, and the patent issued to Marie Amédeé Charles Mellier, May 26th, 1857; and from using any of the inventions or improvements described and claimed in said reissued patents reissued to Ladd & Keen, and in said patent issued to said Mellier, in the manufacture of paper pulp from wood or other vegetable substances, and in the manufacture of paper from wood; and from infringing upon or violating the said reissued letters patent reissued to the said Ladd & Keen, and the patent issued to the said Mellier, in respect of the exclusive rights vested in your orators.

26 And that all such infringing paper, or paper pulp may be forthwith destroyed or delivered up to your orators; and that the defendants may be decreed to pay the costs of this suit; and that your your orators may have such other relief as the equity of the case may require, and as to your honors may seem meet.

To the end therefore, that the said defendant may, if they can,

show why your orators should not have the relief hereby prayed, and may full, true, and direct answer make, according to the best of their knowledge, remembrance, information and belief, to the several matters hereinbefore averred and set forth, as fully and particularly as if the same were here repeated, paragraph by paragraph, and they specially interrogated thereunto severally, may it please your honors to give unto your orators a writ of subpœna ad respondendum, issuing out of and under the seal of this honorable court, directed to the said defendants commanding them to appear and make answer to this bill of complaint, and to perform and abide by such order and decree herein as to this court may seem required by the principles of equity and good conscience.

May it please your honors to grant unto your orators a provisional or preliminary injunction, issuing out of and under the seal of this honorable court, enjoining and restraining the defendants, their attorneys, solicitors, servants, workmen, and agents to the same purport, tenor, and effect hereinbefore prayed for in regard to said perpetual injunction.

And your orators will ever pray.

AMERICAN WOOD PAPER COMPANY,
By B. BUFFUM, *Treasurer.*
H. E. WALLACE,
Solicitors for Complainants.
T. A. JENCKES, *of Counsel.*

27 DISTRICT OF RHODE ISLAND, *ss*:

I, Benjamin Buffum, treasurer of the said American Wood Paper Company, do solemnly affirmed that the facts and statements in said bill contained, which are made upon knowledge, are true, to the knowledge of this affiant, and that those which are made upon information and belief, are true, according to the best of his information and belief, and according to the best of the information and belief of said complainants.

BENJAMIN BUFFUM.

Subscribed and affirmed to before me this 24th day of August, A. D. 1865.

JAMES H. PARSONS.
U. S. Commissioner for said district.

28
29 *Exhibit "A."—Reissue No.* 1,448.

THE UNITED STATES OF AMERICA.

To all to whom these Letters Patent shall come:

Whereas, William F. Ladd, of New York, New York, and Morris L. Keen, of Philadelphia, Pennsylvania, assignees (through mesne assignments) of Charles Watt and Hugh Burgess, of London, England, have alleged that said Charles Watt and Hugh Burgess invented a new and useful improved pulp from wood, &c., for the manufacture

of paper, (for which letters patent were issued to them, dated July 18, 1854, and ante-dated August 19, 1853, the same surrendered by said assignees, and new letters issued to them on an amended specification, dated October 5, 1858, which last letters having been surrendered by them, the same have been cancelled, and new letters ordered to issue to them, on two separate amended specifications,) which they stated had not been known or used before their application, had made oath that they were subjects of the Queen of Great Britain, that they did verily believe that they were the original and first inventors or discoverers of the said invention, and that the same hath not, to the best of their knowledge and belief, been previously known or used; said Ladd and Keen having paid into the Treasury of the United States the sum of thirty dollars, and presented a petition to the Commissioner of Patents signifying a desire of obtaining an exclusive property in the said invention, and praying that a patent may be granted for that purpose.

These are, therefore, to grant, according to law, to the said William F. Ladd and Morris L. Keen, their heirs, administrators, or assigns, for the term of fourteen years from the nineteenth day of August, one thousand eight hundred and fifty-three, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said invention, a description whereof is given in the words of the said Ladd and Keen, in the schedule hereunto annexed, and is made a part of these presents.

In testimony whereof, I have caused these letters to be made patent, and the seal of the Patent Office has been hereunto affixed.

Given under my hand at the city of Washington, this seventh day of April, in the year of our Lord one thousand eight hundred and sixty-three, and of the independence of the United States of America the eighty-seventh.

(Signed) J. P. USHER,
Sec'y of the Interior.

Countersigned and sealed with the seal of the Patent Office.
(Signed) D. P. HOLLOWAY,
Commissioner of Patents.

The schedule referred to in these letters patent, and making part of the same.

To all whom it may concern :

Be it known, that Charles Watt and Hugh Burgess, of London, England, did invent a new and useful improvement in the manufacture of paper pulp from wood and other vegetable substances, and that the following is a full, clear, and exact description thereof :

The wood or vegetable substance from which it is intended to make the pulp should be first reduced to fine shavings or cuttings. This may be done in any suitable machine.

The shavings or cuttings of wood, or the vegetable substances, are then to be boiled in a solution of caustic alkali, in a suitable boiler,

under pressure. The strength of the alkali is dependent on the nature of the vegetable substance used and operated upon. For non-resinous woods, a solution of alkali, of the strength indicated by 70° of the English hydrometer, or thereabouts, answer very well, and for deal, pine, or fir wood, or other woods containing resinous matter, a strength of about 12° is sufficient, but varying with
31 the nature of the vegetable substance being acted upon, to a strength of about 10 degrees. The varied nature of the vegetable subtance to be operated upon is such, that only general directions can be given for the strength of the alkali, or the degree of heat to be used, or the duration of the operation. Boiling in a solution of caustic alkali, under pressure, is of essential importance.

By the words "under pressure," is meant a pressure at, near, or above 300 degrees of Fahrenheit's scale, which is the ordinary pressure used, but a heat and corresponding pressure of from 300 to 500 degrees may be used, according to the nature of the vegetable substance to be treated, whether resinous or non-resinous, or otherwise, and the time may be from four to twelve hours, according to the nature of the substance.

After the vegetable substance has been thus operated upon by caustic alkali, under heat and pressure for the requisite time, as above described, it should be discharged from the boiler, while under pressure, into a tank or other reservoir, with proper safety valves and pipes for the discharge of the steam, and should be drawn as soon as the steam shall have escaped into open vats, where it can be operated upon in the next stage of the process, or it may be drawn directly into the vats from the boiler.

The vats which receive the wood shavings or cuttings, or other vegetable substances being formed into pulp, should be constructed with suitable means of drainage. The alkaline solutions must then be removed from the pulp, either by percolation and subsequent washing in the vats, or by pressure in any convenient apparatus and subsequent washing. The mode of percolation has generally been found sufficient.

The alkaline solutions thus obtained may be saved and evaporated down, and the residuum burned in a furnace suitably constructed, so as to prepare the alkaline substances for use in a repetition of the same process. The alkaline solutions having been removed by percolation and washing, or by pressure and washing, the wet mass of woody or vegetable pulp is now to be exposed to the action of chlorine, or the compounds of clorine with oxygen, for the purpose of bleaching it, and preparing it for the manufacture of
32 white paper. Brown, colored, or unbleached paper of a good quality, can be produced from the pulp as soon as the alkaline solutions are removed; but for the production of good white paper it is necessary to subject the pulp to the bleaching process. If the material used be wood or vegetable substance of a non-resinous nature, the pulp may be bleached by subjecting it to the action of chlorine in a gaseous form, or, which is preferable in this case, in an aqueous solution, in any of the common and well known modes.

If the wood or vegetable substance be of a resinous nature, the alkaline solutions should be removed by the mode above described, and the pulpy mass should be exposed to the action of chlorine, or its compounds with exygen. This may be done by placing the pulpy mass of woody or vegetable substance on racks or drawers arranged in a chamber, and applying chlorine, or its compounds with oxygen, in the gaseous form, which, with resinous substances, is preferable to the aqueous solution, until the mass is sufficiently acted upon. The mass must then be again well washed and treated with a weak solution of caustic alkali, warm preferred, which changes the red color to a dark brown. The alkaline solution should then be removed by washing, and the resulting gray pulp may be bleached by any ordinary method of bleaching.

What we claim in this patent, as the invention of Charles Watt and Hugh Burgess, as a new article of manufacture, is a pulp suitable for the manufacture of paper, made from wood or other vegetable substances, by boiling the wood or other vegetable substance in an alkali under pressure, substantially as described.

(Signed) WILLIAM F. LADD.

Witnesses to W. F. LADD—
JONATHAN S. ODELL.
SAML. COLES.

(Signed) MORRIS L. KEEN.

Witnesses to M. L. KEEN—
GEO. C. WARD.
PATRICK WARD.

33 *Exhibit "B."—Reissue No.* 1,449.

THE UNITED STATES OF AMERICA :

To all to whom these letters patent shall come :

Whereas, Wm. F. Ladd, of New York, New York, and Morris L. Keen, of Philadelphia, Pennsylvania, assignees, (through mesne assignments) of Charles Watt and Hugh Burgess, of London, England, have alleged that said Charles Watt and Hugh Burgess invented a new and useful improved process of treating wood and other vegetable substances, in the manufacture of paper pulp, (for which letters patent were issued to them, dated July 18, 1854, and antedated August 19, 1853, the same surrendered by said assignees, and new letters issued to them on an amended specification, dated October 5, 1858, which last letters having been surrendered by them, the same have been cancelled, and new letters ordered to issue to them on two separate amended specifications) which they stated had not been known or used before their application, had made oath that they were subjects of the Queen of Great Britain, that they did verily believe that they were the original and first inventors or discoverers of the said invention, and that the same hath not, to the best of their knowledge and belief, been previously known or used ; said Ladd and Keen having paid into the treasury of the United States, the sum of thirty dollars, and presented a petition to the Commissioner

of Patents, signifying a desire of obtaining an exclusive property in the said invention, and praying that a patent may be granted for that purpose.

These are therefore, to grant, according to law, to the said William F. Ladd and Morris L. Keen, their heirs, administrators, or assigns, for the term of fourteen years, from the 19th day of
34 August, one thousand eight hundred and fifty-three, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said invention, a description whereof is given in the words of the said Ladd and Keen, in the schedule hereunto annexed, and is made a part of these presents.

In testimony whereof, I have caused these letters to be made patent, and the seal of the Patent Office has been hereunto affixed.

Given under my hand, at the city of Washington, this seventh day of April, in the year of our Lord, one thousand eight hundred and sixty-three, and of the independence of the United States of America the eighty-seventh.

(Signed) J. P. USHER,
Secretnry of the Interior.

Countersigned and sealed with the seal of the Patent Office.

(Signed) D. P. HOLLOWAY,
Commissioner of Patents.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern :

Be it known, that Charles Watt and Hugh Burgess, of London, England, did invent, make, and apply to use, certain improvements in pulping and disintegrating wood and other vegetable substances for which letters patent were granted to them by her Majesty the Queen of Great Britain, bearing date the 19th of August, 1853, and we do hereby declare that the following is a full, clear, and exact description of said invention, and of the mode of carrying out the same in practice.

The wood or vegetable substances upon which it is intended to operate by this process should first be reduced to fine shavings or cuttings. This may be done in any suitable machine.

35 The shavings or cuttings of wood, or the vegetable substances, are then to be boiled in a solution of caustic alkali, in a suitable boiler, under pressure. The strength of the alkali is dependent upon the nature of the vegetable substance used and operated upon. For non-resinous woods, a solution of alkali of the strength indicated by 17° of the English hydrometer, or thereabouts, answers very well ; and for deal, pine, or fir-wood, or other woods containing resionous matter, a strength of about 12° is sufficient, but varying with the nature of the vegetable substance to be acted upon, to a strength of about 10 deg. The varied nature of the vegetable

substance to be acted upon is such that only general directions can be given for the strength of the alkali, or the degree of heat to be used, or the duration of the operation. Boiling in a solution of caustic alkali, under pressure, is of essential importance. By the words "under pressure," is meant a pressure at, near, or above 300 degs. of Fahrenheit's scale, which is the ordinary pressure used, but a heat and corresponding pressure of from 300 to 500 degrees may be used, according to the nature of the vegetable substance to be treated, whether resionous or non-resionous, or otherwise, and the time may be from four to twelve hours, according to the nature of the substance.

After the vegetable substance has been thus operated upon by caustic alkali, under heat and pressure for the requisite time, as above described, it should be discharged from the boiler while under pressure into a tank or other reservoir, with proper safety valves and pipes, for the discharge of the steam, and should be drawn, as soon as the steam shall have escaped, into open vats, where it can be operated upon in the next stage of the process, as it may be drawn directly into the vats from the boiler. The vats which receive the wood shavings or cuttings, or other vegetable substances, being formed into pulp should be constructed with suitable means of drainage.

The alkaline solutions must then be removed from the pulp, either by percolation and subsequent washing in the vats, or by pressure in any convenient apparatus and subsequent washing. The mode of percolation has generally been found sufficient. The alkaline solutions thus obtained may be saved, and evaporated down, and the residuum burned in a furnace suitably constructed, so as to
36 prepare the alkaline substances for use in a repetition of the same process.

The alkaline solution having been removed by percolation and washing, or by pressure and washing, the wet mass of woody or vegetable pulp is now to be exposed to the action of chlorine or the compounds of chlorine with oxygen, for the purpose of bleaching it, and preparing it for the manufacture of white paper. Brown, colored, or unbleached paper of a good quality can be produced from the pulp as soon as the alkaline solutions are removed, but for the production of good white paper, it is necessary to subject the pulp to the bleaching process.

If the material used be wood, or vegetable substance of a non-resinous nature, the pulp may be bleached by subjecting it to the action of chlorine in a gaseous form, or, which is preferable in this case, in an aqueous solution, in any of the common and well known modes.

If the wood or vegetable substance be of a resinous nature, the alkaline solution should be removed by the mode above described, and the pulpy mass should be exposed to the action of chlorine, or its compounds with oxygen. This may be done by placing the pulpy mass of woody or vegetable substance on racks or drawers arranged in a chamber, and applying chlorine, or its compounds with oxygen

in the gaseous form, which with resinous substances is preferable to the aqueous solution, until the mass is sufficiently acted upon. The mass must then be again well washed, and treated with a weak solution of caustic alkali, warm preferred, which changes the red color to a dark brown. The alkaline solution should then be removed by washing, and the resulting grey pulp may be bleached by any ordinary method of bleaching.

What we claim as the invention of Charles Watt and Hugh Burgess, is, first—

The process of treating wood or other vegetable substance by boiling in an alkali under pressure as a process, or preparatory process for making pulp for the manufacture of paper from such woods, or other vegetable substances, substantially as described.

37 We also claim the process of treating resinous woods by boiling in an alkali under pressure, and treating the product with chlorine and its compounds with oxygen, for making white pulp, for the manufacture of paper from such woods, substantially as described.

(Signed) WILLIAM F. LADD.

Witnesses to W. F. Ladd—
GEORGE C. WARD.
SAMUEL COLES.

(Signed) MORRIS L. KEEN.

Witnesses to M. L. Keen—
GEORGE C. WARD.
PATRICK WARD.

38 *Exhibit "C."*

Know all men by these presents, that we, William F. Ladd, of Tarrytown, Westchester county, and State of New York, and Morris L. Keen, of Rogers' Ford, county of Montgomery, and State of Pennsylvania, in consideration of the sum of one dollar and other valuable considerations, received, to our full satisfaction, of Benjamin Buffum, of the city and county of Providence, and State of Rhode Island, trustee for the American Wood Paper Company, do hereby bargain, sell, assign, transfer, and convey unto said Benjamin Buffum, trustee as aforesaid, and to said American Wood Paper Company, their successors and assigns, all our right, title, and interest in and to letters patent of the United States, originally granted to Charles Watt and Hugh Burgess, of London, England, dated July 18th, A. D. 1854, antedated August 19th, A. D. 1853, and by the said Charles Watt and Hugh Burgess, assigned to Frederic B. Houghton, by indenture made November 22d, A. D. 1854, and by the said Frederic B. Houghton, on the 20th day of March, A. D. 1855, by indenture assigned to us, the grantors, and by us surrendered, and new letters issued to us on an amended specification, dated October 5th, 1858, and again by us surrendered, and again reissued to us in two letters

patent, numbered reissue No. 1,448 and reissue No. 1,449, bearing date the 7th day of April, A. D. 1863, which reissued letters patent are entitled as follows: No. 1,448 "for improved pulp from wood, &c., for the manufacture of paper," and No. 1,449, "for improved process of treating wood and other vegetable substances in the manufacture of paper pulp," our said right, title, and interest in said reissued letters patent being the entire title thereto; to have and to hold the said reissued letters patent to the said Buffum, trustee, as aforesaid, and to said American Wood Paper Company, their successors and assigns, with all rights and things incident thereto, or growing out of the same, and all claims for damages or profits
39 against all infringers of said reissued letters patent, for, and during the period from the dates of said reissued letters, till the expiration of the term for which said letters patent were originally granted, and for such other terms or periods as we have a right in or title to the same.

And we dc hereby constitute and appoint the said Benjamin Buffum, trustee, as aforesaid, and the said American Wood Paper Company, their successors and assigns, our true and lawful attorney, and attorneys, to claim, demand, sue for, and recover to their use any and all damages or profits to which we may be entitled for infringement of said reissued letters patent, the same being done without expense to us.

In testimony whereof we have hereunto set our hands and seal this eighteenth day of May, A. D. eighteen hundred and sixty-three, at our several places of residence as hereinbefore mentioned.

[L. S.] (Signed) WM. F. LADD,
[L. S.] MORRIS L. KEEN,

Executed and delivered in presence of—

Witness signature of Morris L. Keen—
WM. GOODWIN.
JOHN FARRELL.

Witness signature of Wm. F. Ladd—
A. J. DELATOUR.
GEORGE W. WILLS.

U. S. PATENT OFFICE.

Received and recorded Oct. 23d, 1863, in liber D 7, page 113, of transfers of patents.

In testimony whereof I have caused the seal of the Patent Office to be hereunto affixed.

(Signed) D. P. HOLLOWAY,
Comm'r of Patents.

40 *Exhibit "D."*

Whereas, William F. Ladd, of Tarrytown, Westchester county, and State of New York, and Morris L. Keen, of Rogers' Ford, county of Montgomery, and State of Pennsylaania, by instrument in writing

bearing date the eighteenth day of May, A. D. eighteen hundred and sixty-three, conveyed to Benjamin Buffum, of the city and county of Providence, State of Rhode Island, as trustee for the American Wood Paper Company, all their right, title, and interest in and to letters patent of the United States originally granted to Charles Watt and Hugh Burgess, of London, England, dated July 18th, A. D. 1854, antedated August 19th, A. D. 1853, and by the said Charles Watt and Hugh Burgess assigned to Frederick B. Houghton by indenture made November 22d, A. D. 1854, and by the said Frederic B. Houghton on the 20th day of March, A. D. 1855, by indenture assigned to them, the grantors, and by them surrendered, and new letters issued to them on an amended specification dated October 5th, A. D. 1858, and again by them surrendered, and again reissued to them in two letters patent, numbered reissue No. 1,448 and reissue No. 1,449, bearing date the seventh day of April, A. D. 1863, which reissued letters patent are entitled as follows: No. 1,448, "For improved pulp from wood, &c., for the manufacture of paper," and No. 1,449, "For improved process of treating wood and other vegetable substance in the manufacture of paper pulp," their said right, title, and interest in said reissued letters patent, being the entire title thereto.

Now, therefore, I, the said Benjamin Buffum, in consideration of one dollar and other valuable considerations received to my full satisfaction from said American Wood Paper Company, a corporation created by the general assembly of the State of Rhode Island, do hereby transfer and convey unto said corporation, their successors and assigns all the right, title, and interest in said letters
41 patent and in the improvements therein described, conveyed to me as trustee by the instrument aforesaid, and I do hereby substitute the aforesaid American Wood Paper Company, their successors and assigns, to all powers, rights, and privileges granted to me by the instrument aforesaid, aud secured to me by the covenants therein contained and set forth.

In testimony whereof I have hereunto set my hand and seal this sixteenth day of June, A. D. eighteen hundred and sixty-five.

[L. S.] (Signed) BENJAMIN BUFFUM.

Executed and delivered in presence of—
ALFRED K. HALL.
ALFRED R. KING.

42 *Exhibit "E."—No.* 17,387.

THE UNITED STATES OF AMERICA:

To whom all these letters patent shall come:

Whereas, Marie Amédeé Charles Mellier, of Paris, France, has alleged that he has invented a new and useful improvement in making paper pulp, which he states has not been known or used before his application; has made oath that he is a citizen of France; that he

does verily believe that he is the original and first inventor or discoverer of the said improvement, and that the same hath not, to the best of his knowledge and belief, been previously known or used; has paid into the Treasury of the United States the sum of three hundred dollars, and presented a petition to the Commissioner of Patents signifying a desire of obtaining an exclusive property in said improvement, and praying that a patent may be granted for the purpose.

These are, therefore, to grant, according to law, to the said Marie Amédeé Charles Mellier, his heirs, administrators, or assigns, for the term of fourteen years from the seventh day of August, one thousand eight hundred and fifty-four, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used the said improvement, a description whereof is given in the words of the said Mellier in the schedule hereunto annexed, and is made a part of these presents.

In testimony whereof, I have caused these letters to be made patent, and the seal of the Patent Office has been hereunto affixed.

Given under my hand, at the city of Washington, this
43 twenty-sixth day of May, in the year of our Lord one thousand eight hundred and fifty-seven, and of the independence of the United States of America the eighty-first.

(Signed) JACOB THOMPSON,
Sec'y of the Interior.

Countersigned and sealed with the seal of the Patent Office.
(Signed) C. MASON,
Commissioner of Patents.

The schedule referred to in these letters patent, and making part of the same.

To all whom it may concern:

Be it known that I, Marie Amédeé Charles Mellier of Paris, in the Empire of France, have made an invention for an improvement in the manufacture of paper, and I do hereby declare that the following is a full and exact description:

The invention has for its object a peculiar process for the treating of straw and other vegetable fibrous materials requiring like treatment preparatory to the use of such fibres in the manufacture of paper; and the improvement consists in subjecting straw or such other fibrous materials to a pressure of at least seventy pounds on the square inch, when boiling such fibrous matters in a solution of caustic alkali. For this purpose the straw or fibrous matters are cut into short lengths, soaked in warm water, and washed. They are then placed in a suitable boiler; and I use for such purpose a rotary boiler, provided with a coil or coils of steam pipe for the purpose of heating the contents, and I prefer that the boiling should be carried on at a temperature to produce at or about eighty pounds on the square inch in the boiler where are the fibrous materials to be acted

upon. But so high a temperature is not absolutely necessary; for I have found by experiment that it is essential that a temperature equivalent to seventy pounds on the square inch must be em-
44 ployed. The quantity of alkali used is at the rate of about sixteen per cent. of caustic soda or potash of the straw of fibrous substance under process. The fibres may then be bleached by the use of a comparatively small quantity of bleaching powder or chloride of lime.

To enable others skilled in the art to make and use my invention, I will proceed to describe more fully the manner of using the same. The straw or other fibrous material requiring a like process to prepare the same for the paper manufacture, is first, as heretofore. to be cut in a chaff cutting or other machine into short lengths, and to be freed from knots, dirt, and dust, and then steeped for a few hours in hot water. The straw or fibrous materials and a weak solution of caustic alkali are then to be placed in a suitable close boiler, heated by steam, as hereafter explained, and the heat is to be raised to such a degree as to attain and maintain for a time a pressure internally of the boiler equal to or exceeding seventy pounds on the square inch. that is, about 310° of Fahrenheit, by which means a considerable saving of alkali, as well as time and fuel, results, as compared with the means of using a hot solution of caustic alkali, as now practiced in preparing straw and other fibres for paper makers. The boiler employed for the purpose, and the manner of heating it by steam, may be varied. But, first, it must have a rotary motion, either on its long or on its small axis, by means which are very well known; and secondly, I prefer not to send the steam directly into the liquid in which the materials are immersed, but to pass it either in a jacket around the boiler, or through a coil, or a system of steam pipes inside of it, so that the steam does not mix with the caustic alkaline solution in the middle portion of the boiler, but is kept separate, and does not, therefore, in condensing, dilute the caustic alkaline solution used. The plan of construction of the boiler I would recommend would be, if the boiler is to rotate vertically or on its small axis, as very well known, to cover it with a jacket so that the steam could circulate from one end to the other between the two plates, or rather, if it is to revolve horizontally or upon its long axis, as is equally very well known, to fix near each end of the boiler, and inside of it, a dia-
45 phragm or partition, which partitions are connected together by numerous tubes, which are arranged in a circle near the outer circumference of each partition. By this arrangement the steam is introduced through the hollow axis at one end of the boiler, and it passes through the steam pipes, and thence into the compartment at the other end of the boiler, where it and the condensed steam are conveyed away, as is understood, through the other hollow axis. In adopting the plan of not sending directly the steam into the boiler, I found the three following advantages: 1st, not to dilute, as I have already said, the alkaline solution; 2d, to avoid the trouble of having sometimes the end of the steam pipe in the boiler choked with straw, and to prevent, in case that by one cause or another, the

pressure in the steam boiler would fall under the degree of the pressure in the straw boiler, the priming of the first by the second, viz., the absorption of straw and alkaline solution from the straw boiler into the steam boiler; 3d, the greater facility of cooling the straw boiler when the pressure has been maintained for a sufficient length of time, by means of turning off the steam at one end, letting it at the other end out of the jacket, or of the coils or steam pipes just described, and passing through the same a stream of cold water, which, at the same time that it cools the mass, furnishes a quantity of cold water, which can be received in convenient vessels, and will be found very useful for washing the straw or other fibrous materials after boiling.

By means of submitting the straw or similar fibrous materials to a pressure of between 70 to 84 pounds on the square inch inside of the boiler, I can reduce considerably the proportion of alkali, and the solution which I prefer to use is to be from two to three degrees of Baumé, or of a specific gravity of from 1.013 to 1.020, and at the rate of about 70 gallons of such solution to each cwt. of straw or other fibrous vegetable matters requiring like treatment.

The boiler is to be filled with straw and alkaline solution, and then closed fluid and steam tight. The boiler is made to revolve slowly, say about one or two revolutions per minute, and the steam is to be admitted. I find it desirable to keep up the heat and pressure during about three hours after the pressure above-mentioned has been obtained when the process of boiling is complete. A steam gauge properly fixed upon the boiler will enable one to ascertain when the
46 pressure has attained the required degree. When the apparatus and the fibres under process have been cooled by the means hereinbefore mentioned, or rather when the pressure has been reduced to nothing, I open the man hole of the boiler, empty the materials in suitable vessels, and wash them first with hot water, then with cold water, until the liquor runs perfectly clear. I then steep the fibre for about an hour in hot water accidulated with a quantity of sulphuric acid, equal to about two per cent. of the weight of the fibres under process, and finally the washing is completed with cold water. The straw or fibre may then be bleached in the ordinary manner, and it will be found to be accomplished by a comparatively small quantity of chloride of lime.

Having thus described the nature of my said invention, and the manner of performing the same, I would have it understood that I do not claim the general use of caustic alkaline solutions, nor the employment generally of a close boiler for boiling straw or other vegetable fibrous substances.

But what I claim as my invention, and desire to secure by letters patent, is the use of a solution of caustic soda (Na °) in a compartment of a rotary vessel, separate from that which contains the steam heat, substantially as described.

I also claim the within-described process for bleaching straw' consisting in boiling it in a solution of pure caustic soda (Na °) from 2° to 3° Baumé, at a temperature not less that 310° Fahrenheit,

after it has been soaked and cleaned, and before submitting it to the action of a solution of chloride of lime, from 1 to 1½ degrees, substantially as described.

(Signed) A. M. MELLIER.

Witnesses—

ALLERME.

E. MARZEY.

47 *Exhibit "F."*

Know all men by these presents that I, Marie Amédeé Mellier, of New York, have made, constituted, and appointed, and do hereby make, constitute, and appoint Victor Beaumont, civil engineer, of New York, for my lawful attorney, for me and in my name, place, and stead, to manage, use, and sell, and to do all and everything whatsoever in and about, or resulting from the management, use, and sale of any letters patent issued, or to be issued, by the government of the United states to me, in whole or in part, and any part of any such letters patent and of any invention or improvement patented thereby, and the right to use the same, and for that purpose to make, sign, seal, execute, and deliver all and every deed or other instrument under seal or otherwise, giving and granting to my said attorney full power and authority to do and perform all and every act and thing whatsoever, requisite and necessary to be done in and about the premises, as fully to all intents and purposes as I might or could do if personally present, with full powers of substitution and revocation, I hereby ratifying and confirming all that my said attorney or his substitute or substitutes shall lawfully do, or cause to be done, by virtue hereof.

In witness whereof, I have hereunto set my hand and seal the 23d day of June, in the year one thousand eight hundred and fifty-four.

[L. S.] (Signed) M. A. C. MELLIER.

Signed, sealed, and delivered in psesence of

WILLIAM HENRY WALLACE.

EDWARD GIFFORD.

CITY AND COUNTY OF NEW YORK, *ss*:

On this 23d day of June, A. D. 1854, before me, personally came Marie A. C. Mellier, known to me to be the person described
48 in and who executed the foregoing power-of-attorney, who acknowledged to me that he executed the same.

DAVID J. CHATFIELD,
Comm'r of Deeds.

Mr. O'BRIEN.

U. S. PATENT OFFICE.

Received and recorded March 15th, 1862, in Liber L 6, page 279, of Transfers of Patents.

In testimony whereof, I have caused the seal of the Patent Office to be hereunto affixed.

D. P. HOLLOWAY,
Comm'r of Patents.

49 *Exhibit "G."*

Whereas, I, Marie Amédeè Charles Mellier, of Paris, France, did obtain letters patent of the United States for certain improvements in making paper pulp, which letters patent bear date the 26th day of May, 1857; and whereas, Coe S. Buchanan, of Saratoga county, and State of New York, has purchased of me the right to use said patent for and in the whole of the United States of America and its Territories: Now, this indenture witnesseth, that for and in consideration of money already advanced, amounting to about fourteen hundred dollars, ($1,400) by the said Coe S. Buchanan to said Marie Amédeé Charles Mellier, the parties to this instrument, and in consideration of the said Buchanan paying and agreeing to pay the said Mellier one-half of all the net receipts of said patent in the sales of rights to use the same in any and all places in the United States, I have assigned, sold, and set over, and do hereby assign, sell, and set over unto the said Coe S. Buchanan, all the right, title, and interest which I have in the said invention, as secured to me by the said patent for, to, and in the United States of America and its Territories, the same to be held and enjoyed by the said Coe S. Buchanan for his own use and behoof, and for the use and behoof of his legal representatives, to the full end of the term for which said letters patent are or may be granted, as fully and entirely as the same would have been held and enjoyed by me had this assignment and sale not been made.

In testimony whereof, I hereunto set my hand and affix my seal this nineteenth day of June, A. D. 1857.

[L. S.] A. MELLIER,
By V. BEAUMONT, *Attorney.*

Sealed and delivered in presence of—
JOS. HENRY NASH, 36 Beckman st.

50 STATE, CITY, AND COUNTY OF NEW YORK, *ss*:

On this 19th day of June, A. D. 1857, personally appeared before me Victor Beaumont, known to me to be the same person who executed the foregoing instrument, who acknowledged that he executed the same as the act and deed of A. Mellier therein described, by virtue of a power-of-attorney, duly executed by the said A. Mellier, bearing date the 23d day of June, A. D. 1854, and acknowledged before a commissioner of deeds on the same day.

JOS. HENRY NASH,
Comm'r of Deeds, 36 *Beckman st.*

U. S. PATENT OFFICE.

Received June 25, 1857, and recorded in Liber M 4, page 98, of Transfers of Patents.

In testimony whereof, I have caused the seal of the Patent Office to be hereunto affixed.

C. MASON,
Comm'r of Patents.

In the Circuit Court of the United States for the northern district of New York, in the second circuit.

51 *Exhibit "H."*

COE S. BUCHANAN
vs.
GARDNER HOWLAND and JOSEPH B. PALSER. } In equity.

Messrs. Tiffany & Keller, for plaintiff; Messrs. Gale & Beach, for defendants.

Hall, district judge.

This suit is founded on letters patent granted to Marie Amédeé Charles Mellier, of Paris, France, on the 26th of May, 1857, for fourteen years from the 7th day of August, 1854, for "a new and useful improvement in making paper pulp."

The bill alleges an infringement of the rights of the plaintiff, as the the assignee and owner of this patent; and it prays a permanent injunction, and an account of profits, substantially in the accustomed form.

The specification annexed to these letters patent is in the following words:*

The answer of the defendants admits the letters patent and the assignment thereof to the plaintiff, and also that "the said Amédeé invented the particular mode in said letters patent described (to wit, by two separate steam-tight compartments,) of separating the steam heat from such material whilst boiling the same, in a rotary
52 vessel, in a solution of caustic alkali; and also invented the soaking and cleaning of such material before boiling the same in a solution of caustic alkali;" but it denies that the said Amédeé was the inventor of any other idea, process, or improvement. In respect to the residue of the process patented, the defendants' answer alleges that the same was not novel, and it denies the alleged infringements of the patent. It also denies the utility of the invention.

The defendants also set up letters patent granted to themselves on the 20th day of March, 1860, and other letters patent granted to them on the 3d day of July, 1860; and claim that their operations were carried on under such patents and without the use of the invention of Amédeé and without the infringement of this patent.

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* See copy of specifiction attached.

It was conceded at the hearing that there had been no trial at law on which the validity of the patent under which the plaintiff proceeds, had been established; and also that no preliminary injunction had been granted, or even applied for in this suit.

It was, therefore, insisted on behalf of the defendants that no relief could be granted to the plaintiff; that the issues upon which the validity of the patent depends are triable only at law; and that because the plaintiff had not applied for the trial at law, of proper issues to determine the validity of his patent and its infringement, this court should now dismiss his bill, with costs.

In support of these positions, the counsel cited Curtis on Patents, sections 314, 315 (and note 1,) 328, 336, (and note 1;) and Bacon *vs.* Jones, 4 Mylne & Craig, 433. These sections of Mr. Curtis' valuable work, so far as they relate to the questions now under consideration, are based mainly upon the case of Bacon *vs.* Jones, and must therefore be considered in connection with the full report of that case. By that report it appears that the Lord Chancellor, after speaking of applications for injunctions before the final hearing, said: "When the cause comes to a hearing, the court has also a large latitude left to it; and I am far from saying that a cause may not arise in which, even at that stage, the court will be of the opinion that the injunction may be properly granted without having recourse to a trial at law. The conduct and dealing of the parties, the frame of the pleadings, the nature of the patent right, and of the evi-
53 dence by which it was established, these and other circumstances, may combine to produce such a result; although this is certainly not very likely to happen, and I am not aware of any case in which it has happened. Nevertheless, it is a course unquestionably competent to the court, provided a case can be presented which satisfies the mind of the judge, that such a course, if adopted, will do justice."

In the report of the same case before the Master of the Rolls, (the report in Mylne & Craig is of the hearing and decision before the Lord Chancellor, on appeal,) the Master of the Rolls is reported to have said (1 Beavans' Rep., 387;) I think that if a plaintiff be entitled to an injunction on the merits and on the evidence produced at the hearing, he is not to be deprived of that right, because he has not moved for an injunction at a previous stage of the cause." And see Bailey *vs.* Taylor, 1 Russell & Mylne, 76; Isaacs *vs.* Cooper, 4 Washs. C. C. Reps., 259; Wilson *vs.* Tindal, Webster's Patent Cases, 730, note; Hindmarch on Patents, 356.

It is apparent from the report of the case of Bacon *vs.* Jones, and other English cases, that even in the English courts, there is no inflexible rule requiring a court of equity to refuse a permanent injunction upon a final hearing, on the grounds urged in this case; and certainly the American practice has not been such as to sustain the positions of the defendants' counsel. The case of Goodyear *vs.* Day, (2 Wallace, jr., 283, is a case, in many of its features, somewhat like the present; and the opinion of the court, as delivered by Mr. Justice Grice, states very briefly the practice of our courts in respect to this

question, and present his reasons for proceeding to the final disposition of the cause without requiring the verdict of a jury; reasons which apply with such force in the present case.

In the case of Goodyear *vs.* Day, above referred to, Mr. Justice Grier, in delivering the opinion of the court, said: "It is true that in England the chancellor will generally not grant a final and perpetual injunction in patent cases, when the answer denies the validity of the patent, without sending the parties to law to have that question decided. But even there the rule is not absolute or uni-
54 versal; it is a practice founded more on convenience than necessity. It always rests in the sound discretion of the court. A trial at law is ordered by a chancellor to inform his conscience; not because either party may demand it as a right, or that a court of equity is incompetent to judge of questions of fact or of legal titles. In the courts of the United States the practice is by no means so general as in England, or as it would be here if the trouble of trying issues at law devolved upon a different court.

Cases involving inquiries into the most complex and difficult questions of mechanics and philosophy are becoming numerous in the courts. Often questions of originality and infringement of patents, do not depend so much on the credibility of witnesses or the weight of oral testimony, as on the application of principles of science and law to admitted facts. It is true, that in matters of opinion, both mechanics and learned professors will differ widely. But still the question is not to be decided by the number, the credibility, or respectability of such witnesses, but by the force of the reasons given for their respective opinions. It is no reflection on the trial by jury to say, that cases frequently occur, in which ten out of twelve jurors do not understand the principles of science, mathematics, or philosophy necessary to a correct judgment of the case. Besides, much of the time of courts is lost, where twelve men will not agree upon a verdict; or where they have agreed, the conscience of the chancellor instead of feeling enlightened, rejects it altogether.

A select or special jury of philosophers, if they could be got, would perhaps not prove more satisfactory, or obviate the difficulty.

In a late case, involving the validity of Morse's telegraph patents, which was heard in Philadelphia, a final injunction was decreed without a verdict to establish the patents; and many other cases might be cited from other circuits if necessary in support of the practice, showing that the courts of the United States do not always consider it a proper exercise of their discretion to order such issues to be tried at law before granting a final injunction.

In the present case there are many reasons why the court will not thus exercise their discretion:

55 1st. Because this case has heen set down for final hearing on the exhibits and proofs, without any motion or order of the court for such an issue.

2d. After a patient hearing of very able counsel, and a careful consideration of the testimony, the court feel no doubt or difficulty on these questions, which would be removed or confirmed by a verdict.

3d. It would require three or four weeks, at least, to try this case before a jury if this library of testimony were read to them, and at least as many months if the witnesses were examined viva voce, as they probably would be; and, after all this expenditure of time and labor, it is even more probable that from the confusion created by great length of the testimony and argument in court, or the force and effect of those urged from without, no verdict would be obtained, and most certainly none that would alter the present conviction of the court.

The answer of the defendants, in Goodyear *vs.* Day, not only denied the allegations of the bill, but concluded by praying "a trial by jury of the various issues of fact formed by it." The defendant did not, however, make any special motion for the trial of such issues by jury; and this it had been seen was considered by the court as a prominent ground for proceeding to the final determination of the cause without a trial at law.

In this case no prayer for a trial by jury is to be found in the answer, and no special motion for such trial has been made.

The nature of the patent right in this case, and the character of the evidence by which it is to be established or overthrown, are such that I am quite satisfied that, upon the most important questions involved, the conclusions of a judge—based upon repeated examinations and comparisons of depositions carefully taken, reduced to writing, read to and approved by the deponents, after a full cross-examination—would, as a general rule, be more accurate and reliable than the verdict of a jury, which must of necessity be based upon the hasty oral examination of witnesses at a circuit, and made, in the usual manner, after only a brief consultation.

56 It is true that, in regard to the ordinary transactions of life, with which jurors are more familiar, the verdict of a jury is, and ought to be more relied upon than [than] the opinion of a judge, formed during the progress of a trial; but we are not satisfied that an ordinary jury would be the best tribunal to decide upon the questions of fact in this case—questions upon which the very full and yet conflicting testimony of the scientific experts may exercise a very considerable, if not a controlling influence. This testimony ought to be attentively examined, and the testimony of each witness carefully compared with that of every other, and the general facts of the case; and the whole evidence ought then to be made the subject of deliberate consideration. This can be better done by a judge in vacation than by a jury at term; and, as a general rule, a judge is better qualified than an ordinary jury to investigate and determine disputed questions depending in part on the principles and facts of chemistry and of natural philosophy. The case will, therefore, be examined and disposed of without requiring the intervention of a jury.

In disposing of the case upon its merits, we shall first consider the specification and claim of the complainant's patent, with a view of determining the character and extent of the invention patented.

The first claim is in these words: "What I claim as my invention, and desire to secure by letters patent, is the use of a solution of

caustic soda (Na°) in a compartment of a rotary vessel, separate from that which contains the steam heat, substantially as described."

This claim is in one sense a very broad one, as it does not (unless limited by the words "substantially as described,") restrict the claim to the use of a solution of caustic soda, of any indicated degree of strength, to the use of an extraordinary degree of heat, or to any particular form or mode of construction of a comparted rotary vessel, if its construction be such as to make it suitable for the purpose indicated. In another respect it may be quite limited, for (even when considered alone and without reference to the claim which immediately follows it) it is at least doubtful whether it extends to any use of the solution indicated, except in a vessel with compartments
57 so constructed and arranged that the solution is used in a compartment separate and distinct from that which contains the steam heat by which the solution is to be heated.

This claim is substantially for a process, that is for the use of a solution of caustic soda ($Na.\ ^{\circ}$) in a compartment of a rotary vessel, separate from that in which the steam heat is confined when applied for the purposes indicated; and looking to the whole specification and the claims annexed, and especially to the distinct language which expressly limits the process thus claimed to the use of a solution of caustic soda in a compartment of a vessel separate and distinct from another compartment, by means of which the required steam heat is confined and applied, and to the more general and comprehensive terms of the claim which immediately follows it. I am inclined to think this claim cannot be held to extend beyond the use of a vessel with separate compartments for the material to be heated, and for the steam heat used in the process substantially as specified. Such a vessel the defendants do not use, and, therefore, do not infringe the claim of the patent.

It was urged by the counsel for the plaintiff that the use of the designated solution in a rotary boiler without compartments, and heated by a fire under or around the same, was but the substitution of fire heat as a well-known equivalent of the steam heat used by the patentee; but as neither degree of heat nor strength of solution is specified in this claim, and as it, in terms, expressly requires the use of steam heat in one compartment of a vessel with two or more compartments, in the other of which the material to be heated is to be placed, we shall hold that this claim of the plaintiff's patent does not extend to, and is not infringed by, the use of the solution of caustic alkali in a simple single-chambered rotary boiler, heated by fire heat under or around the frame, as practiced by the defendants. And this construction of the first claim of the patent is, we think, very clearly indicated by the different character of the second claim, which is broader in its terms, and embraces the use of the process invented by Mellier, without regard to the mode of applying the heat or the particular form or construction or arrangement of the rotary
58 boiler or apparatus by which the process may be carried on for the purposes indicated.

The second claim in the plaintiff's patent is in these words: "I

also claim the within-described process for bleaching straw, consisting in boiling it in a solution of pure caustic soda, (Na. °,) from 2° to 3° Baumé, at a temperature of not less than 310° Fahrenheit, after it has been soaked and cleansed, and before submitting in to the action of chloride of lime, from 1 to 1½ degrees, substantially as described."

It is evident that the process thus claimed includes only the specified boiling of the material treated in the solution, and under the conditions specified, and that the prior soaking and cleansing of such material, and subsequent treatment of it, by submitting it to the action of chloride of lime, as specified, are not a part of the process thus claimed The soaking of the straw or other material to be heated, like the cutting of it into short lengths and freeing it from dirt and dust, the subsequent washings of the material in hot and cold water, and the bleaching of the cleansed fibre by a comparatively small quantity of chloride of lime, after steeping it in warm water acidulated by sulphuric acid, are not portions of the process claimed and patented; for the patentee, at the commencement of the specification, says: "Improvement consists in subjecting straw or fibrous materials to a pressure of at least seventy pounds on the square inch, when boiling such fibrous matters in a solution of caustic alkali;" and the claim, as has been seen, states the process for bleaching straw, claimed in the second claim, as consisting in boiling it, "under the presented conditions, after it has been soaked and cleansed, and before submitting it to the action of a solution of chloride of lime," &c., thus limiting the process to the boiling, under the conditions thus indicated.

The real discovery of Mellier, the main idea, the spirit or principle of his inveution, was, that the known effects of a solution of pure caustic soda, which had been previously advantageously used for boiling straw and other fibrous materials of similar character and texture in open vessels, in which the heat could be raised to 212° Fahrenheit, might, by the use of a much higher degree of
59 heat, not less than 310° Fahreheit, be advantageously and greatly increased; while the lessening of the time the fibre was subjected to the action of the caustic alkaline solution, and the use of the weaker solution, which could thus be advantageously used, would be less injurious to the fibre, as well as more economical in its use and application. This was the discovery or principle to be developed and practically applied, and he embodied that principle and arranged and described the means of its practical application, for the purposes specified, in the mode and manner particulary described in his specification. This mode, he says, he prefers; and he recommends a particular construction of the boiler as proper to be used in the practical application of the leading idea and principle of his invention. But, aware that inferior forms may be devised by any mechanic, and that superior forms and modes of construction and application may be devised after the use of his process has become familiar, he very wisely makes his second claim broad enough to cover his actual discovery and invention, irrespective of the particular form or construction of the vessel in which the boiling process might be carried on.

The invention and patent are, in some respects, like those of Neilson for the application to the blast furnace of air heated to an extreme degree in a separate vessel intermediate the blowing aparatus and the point where it enters the furnace. In Neilson *vs.* Hartford, the learned Baron Alderson, in respect to Neilson's invention and patent, said: "The blowing apparatus was perfectly well-known; the heating of air was perfectly well-known as applicable to blast furnaces; then what he really discovered is, that it would be better for you to apply air, heated up to red-hot heat, or nearly so, instead of cold air, as you have hitherto done. That is the principal, that is the real discovery; but in order to take out a patent you must have an embodiment of the principle, and his embodiment the principle is the heating of air in a separate vessel immediately between the blowing apparatus and the point where it enters the furnace. Then he says. I do not mean to claim any shape in which it is done ; it may be done in a vessel of any shape, provided only you have a vessel of such shape and fire so applied as that, in the intermediate spaces between the blowing apparatus and the furnace, the air arrives at the red-heat.'" Webster's Patent Cases, 337. And see the Opinion of Lord Justice Clerk Hope, on the same patent, ibid, 683–685.

It was strongly urged by defendants' counsel that "the language of the second claim excludes the idea of every temperature exceeding 310° Fahrenheit;" and it was said, "The term 'of not less than 310° Fahrenheit' has no reference to higher degrees. It names a specific temperature, and provides against less, without including more. The phrase 'not less than' fixes a minimum limit without regard to a maximum."

If this position is well taken, and can be maintained in all its strictness, then most surely the patentee is limited to the precise heat of 310°, and any one may use what is substantially his process with impunity, provided the heat employed is a few degrees above or below the standard thus set up; but we think this position cannot be maintained. It is entirely clear that such was not the intention of the patentee or of the person who drew this specification, for neither could have intended so to limit the claim of the patent as to render it of no practical value. The discovery made was that the higher degrees of heat and pressure could produce the desired result; and, while the minimum heat requisite to produce a really benficial result was stated, no upward limit was fixed, so long as the process carried on by that degree of heat was in fact a boiling process under the conditions, in substance, as stated in the specification.

But it was urged that the Mellier patent was, at all events, limited to the pressure not exceeding 84 pounds to the square inch, because in his specification, he says, that by the use of that pressure he can reduce considerably the proportions of alkali. We think this language does not limit the claim, and that, notwithstanding this language in the specification, the proper construction of the claim is as above stated. Nor do the statements in the specification, that the patentee prefers "that the boiling should be carried on at a temperature to produce at or above 80 pounds pressure on the square in

in the boiler where are the fibrous materials to be acted upon,
61 that "so high a temperature is not absolutely necessary," and that he has "found by experment that it is essential that a temperature equal to 70 pounds on the square inch should be employed," impose any specific upward limit to the degree of heat and pressure. It was urged that the statement that a pressure of 80 pounds was unnecessary, very clearly limited the patentee to that pressure; but we understand that the patentee simply states the fact that so high a pressure is not absolutely essential to a benficial result, but that he prefers a pressure of 80 pounds or more to the square inch, and because by the increased pressure a better result could be produced or a saving of time or alkali could be effected.

Nor do we consider the description of the Mellier process, contained in the specification, "confused, inconsistent, indefinite, ambiguous, or defective." It is sufficiently clear, precise, and intelligible; and, though a higher heat than that used by the patentee, or a longer boiling than he recommends, may be requisite to produce the very best results in the use of the patented process, we are satisfied, from the proofs, that boiling straw, in accordance with that process, for the shortest time and the lowest pressure indicated in the specification, will produce a useful result, one better than that obtained in the same time and at the same cost by the use of the "open tub process."

This brings us to the consideration of the question of novelty in respect to the process referred to in the second claim of the Mellier patent.

The Coupier and Mellier patent had introduced the practice of boiling straw and other fibrous materials, in a pure caustic alkali (free from the presence of lime), for the purpose of separating the coloring matter, and associate constituents or proximates, from the white fibre, or cellulose; and this process of Coupier and Mellier appears to have been the date of its introduction, and, until the subsequent discovery and invention of Mellier, the most advanced stage of the arts, as applied to the purpose of manufacturing white paper from straw, or other refractory material requiring the same material.

It is true that the rotary boiler of Spafford had been invented in 1840, and had been used before Mellier's invention, in the
62 manufacture of paper from other materials, and sometimes, perhaps, from straw, also for boiling stock, under a higher pressure than that used in the open tub process; but we do not understand that Spafford invented or patented, or supposed that he had invented, any new process, but simply a form and construction of boiler, in which, by the turning of the boiler, the steam and the digesting liquid, whatever it might be, were effectually mingled with the charge, or material to be heated, and in which the material heated was thus acted upon by the digesting liquid and heat in a more thorough and equable manner, and with greater economy of heat and time than when boiled in stationary, open tubs or other stationary vessels. As we understand his specification and claim, no intimation is given that the digesting liquid should consist of a solution of pure stic soda of any particular degree of strength; on the contrary,

he speaks of the digesting liquid as a solution of potash, soda, or lime in water; nor do we understand that he indicated any particular degree of heat, or any pressure equal to 310° Fahrenheit, or had discovered, or intended to intimate, that a high degree of heat was useful or desirable. His only object was to produce, by the rotary movement of the vessel containing the charge and the digesting liquid, the complete intermingling of the two, and the perfectly equable action of the digesting liquid upon every portion of the material heated.

There is certainly some testimony, though it is not of the most conclusive character, to show that rope and other refractory material had been boiled in rotaries, at different pressures above seventy pounds, prior to the invention of Mellier, but the liquid used for such boiling was not a solution of pure caustic alkali, but contained lime in considerable quantity, and the extraordinary degree of heat used was not regularly and uniformly attained and kept up, but was rather casual and accidental. We think the whole testimony shows that the parties directing or using this pressure had no knowledge of the utility of the particular process patented by Mellier, nor any conception of the advantages resulting from the use of pure caustic alkali and the high temperatures which he has recommended.

That paper makers and bleachers had, at the date of Mellier's invention, a general knowledge that the boiling of the mate-
63 rial to be bleached, or prepared for bleaching, in an alkaline solution, gave efficiency to the action of the alkali upon such material is certain; but the full and accurate knowledge of the state of the art before possessed by Messrs. Hays and Wells, the defendant's experts, and the long continued experiments of the one, aided by the advice of the other for the purpose of discovering an economical and satisfactory mode or process of making white paper from straw and other similar materials, did not enable them to reach that result or lead them to adopt the process described in Mellier's patent. They abandoned their experiments. They failed to produce white paper from straw with such economy, of such quality and price that its manufacture and sale would give profitable employment to the labor and capital required for that purpose, and neither they nor any of the several manufacturers of paper who have been examined as witnesses in this case were aware of the benefits to be derived from the use of that extreme heat, during the boiling process, which Mellier's process requires. The Coupier and Mellier process was introdouced into this country in 1853; and although the invention of Spafford, of the rotary boiler for boiling rags in 1840, and its subsequent use, had furnished the limit and the means for boiling at much higher temperatures than could be obtained in open vessels, neither the defendants' expert in his experiments, nor the manufacturers or the workmen in the paper mills of the country, ever attempted to use the extraordinary heat now used, or the useful process invented and patented by Mellier. Spafford's rotary had been in use over fifteen years; the Coupier and Mellier process had been in use more than three years, but the Mellier process was nowhere known or in use in the manufacture of white paper from straw until after its invention

was made known to Buchanan and Palser, and probably Howland, late in 1856. Until the defendants, in 1857, entered upon its use, the open tub process of Coupier and Mellier was still in general use when white paper was attempted to be manufactured from straw, and it was not until the French patent of Mellier was exhibited that this process was known in this country. The defendants commenced the manufacture of straw paper in 1857; and on the 22d Novem-
64 ber, 1859 they obtained a patent for an improvement in the manufacture of paper pulp, and in their specification they described a process of boiling straw, in which they say they employ 60 gallons of caustic alkali, of a strength indicating $3\frac{1}{2}°$ to $3\frac{3}{4}°$ of Baume to every one 100 pounds of straw in a rotary steam boiler, and raise the pressure by fire below the boiler to 100 to 130 pounds, and maintain that pressure for four hours.

In this specification they say "A well known method, patented by letters patent, No. 17,387, the same under which plaintiff claims," of reducing straw to pulp is to employ a solution sf caustic alkali, of a strength indicating 2° to 3° Baume, 70 gallons of the solution to 100 pounds of the cut straw, the whole being placed in a boiler and boiled under a pressure of not less than 84 pounds for about three hours, but we find in practice that the above method does not sufficiently disintegrate the straw, nor does it sufficiently dissolve or remove the woody, aluminous and silicious matters from the fibrous portions, &c. And again: "On comparison of the pulp produced from straw by our, and that made after the mode described in the patent beforementioned, a very marked difference in appearance is observable in favor of our invention. The paper made from the pulp above mentioned also presents the same striking difference in favor of our improvement."

This specification seems to show that they had been using the process of Mellier, for it is almost certain upon the proofs in this case, that in that way alone could they have made the discovery and comparison referred to. The specification says: We find in practice," &c., an allegation somewhat inconsistent with some of the allegations of the defendants' answer, and of some of the positions maintained by their counsel on the argument.

Upon the whole evidence in the case we think there is scarcely any reason to doubt that the process now used by the defendants was founded upon the Mellier patent, and the knowledge of the process which they obtained from Buchanan, as shown by the testimony of Godard, of Parks, and of Beaumont; and that the process now used by the defendants is an infringment of the patent held by the plaintiff.

65 It is insisted that the defendants do not use the Mellier process, and various grounds are taken upon which to maintain this position.

It is said that Mellier steeps the straw in warm water and the defendants do not, and that Mellier uses steam heat exclusively, while the defendants use fire heat, almost exclusively. The answer to these allegations is that the steeping in warm water is no part of

the process patented, and that under the second claim of the Mellier patent it is immaterial whether the boiling is produced by steam heat or fire heat.

It is further insisted that Miller separates the alkali from the steam heat to prevent its being diluted, while the defendants admit to the solution all the steam they use, and that Mellier uses 70 gallons of the alkaline solution, from 2° to 3° Baume, while defendants use 60 or 65 gallons at $3\frac{1}{2}$° to $3\frac{3}{4}$° to each 100 pounds of straw. The answer to this argument is that under the second claim of the Mellier patent the admission or exclusion of the heated steam, as stated, is immaterial, and that the evidence satisfactorily shows that by the admission of the steam into the rotary of the defendants, the quantity of alkaline solution used by them is increased and its strength diminished until it becomes both in strength and quantity substantially like, if not identical with, that which plaintiff's patent states is to be employed in the process of Mellier.

It is also insisted that Mellier's specification states that he boils at 70 pounds pressure and regards a higher pressure as unnecessary, except for saving alkali, while defendants boil at 130 pounds pressure to improve the product; and that Mellier boils about three hours, though a much longer boiling is necessary to produce a fair result, provided the strength of alkali and degree of pressure are no greater than he recommends, while the defendants boil four hours. The patent of Mellier, it has been seen, does not limit him to a pressure of 70 lbs. or of 84 lbs. and if the boiling for three hours produces a beneficial result, such as the patent indicates, the defendants can hardly escape the consequences of infringement by continuing the boiling for an hour afterwards in order to produce a better result.

66 Even if it be true, as claimed, that a longer boiling and greater pressure produce better results than can be produced by boiling only three hours with a pressure of 70 lbs., or even of 84 lbs., we see no reason for holding that there is no infringement of the Mellier patent, when the boiling, which he recommends should continue about three hours (although this time is not specifically mentioned in the claim,) is continued for an hour longer than he recommends.

In short, we think that the patent of Mellier is valid; that he is the original and first inventor of the process claimed therein; that his invention is useful; and that the process used at the mills owned and operated by the company in which the plaintiff is a member, and at the mills of the defendants, is in substance Mellier's process, as claimed in the second claim of his patent, and that the plaintiff is entitled to a permanent injunction and an account as prayed for in his bill.

In reaching this result, we have not failed to consider the defendant's patents and their effect. Their patent of November, 1859, referred to in the plaintiff's bill, by the terms of its specification expressly excludes from its scope and operation the process described in the plaintiff's patent, and it was probably granted by the Patent Office on the ground that the claim made, taken in connection with such disclaimer, did not conflict with the claims of the Mellier patent. This

conclusion was probably based upon the facts that the strength of solution in Mellier's was from 2° to 3° Baume, and its quantity about 70 gallons to the 100 pounds of stock, while that in the defendant's process was to be from $3\frac{1}{2}$° to $3\frac{3}{4}$° Baume, and its quantity 60 gallons to the same quantity of stock; and that a higher degree of heat was never needed, differences which were probably considered sufficient to make two processes substantially different.

In considering the process of this patent in connection with the Mellier process, and the defendants' present practice, it is to be remembered that the specification directs that this stronger solution be placed in a boiler and heated entirely by a fire applied below it, and without any introduction and condensation of steam from any other boiler to increase the quantity and diminish the strength of the alkaline solution used, as has been since practiced by the
67 defendants. The specification of Mellier also recommended a construction of the boiler which prevented any increase of quantity or diminution of strength in the use of his process; and this was desirable if the weaker solution of alkali recommended by him was to be used. The proof shows that by the introduction and condensation of steam from another boiler the alkaline solution in defendants' rotary is increased about twenty per cent. in quantity, while its strength is consequently diminished until it is not beyond 3° Baume, thus making the quantity of strength substantially that required by the Mellier process, and the strength much less than that recommended in the defendants' patent of 1859. This shows that the defendants do not now in fact use only 60 gallons of the alkaline liquid to the 100 pounds of stock, or use that at the higher strength required by their first patent, and doubtless for the reason that their present process (in substance the Mellier process) gives a better result.

The patent to the defendants, granted March 20th, 1860, we regard as in substance a patent for the staple fibre produced by the process patented in November, 1859, and as standing or falling with that patent.

The patent of the 3d of July, 1860, describes at great length an ingenious and useful apparatus, and the particular mode or process adopted in their use for the purposes indicted. This patent does not claim the apparatus described (although if it was invented by the defendants, or either of them, it is probably covered by some other patent,) and the specification is not of such a character as to suggest that the claim was in conflict with that of the Mellier patent. The entire process described embraces the use of apparatus entirely different from that particularly specified in the Mellier patent, and the claim in this patent was more likely to be allowed without the consideration of the Mellier patent than the claim of the patent on November, 1859, above-referred to.

It is not shown that the question of interference in respect to these patents of the defendants' and the Mellier patent was even considered by the Patent Office, and if it was, there is no proof that the facts shown in this case was then presented. Our judgment is, that

68 these patents of the defendants' ought not to prevent a decree for the plaintiff in this suit.

There will be a decree for a permanent injunction, and an account stantially as prayed for in the plaintiff's bill.

March 23, 1863.

Schedule referred to in letters patent of the United States to Charles Mellier, dated May 26, 1857.

Be it known, that I, Marie Amedee, of Paris, in the empire of France, have made an invention for an improvement in the manufacture of paper, and I do hereby declare that the following is a full and exact description:

The invention has for its object a peculiar process for the treating of straw, and other vegetable fibrous materials requiring like treatment, preparatory to the use of such fibres in the manufacture of paper; and the improvement consists in subjecting straw, or such other fibrous materials, to a pressure of at least seventy pounds on the square inch, when boiling such fibrous matters in a solution of caustic alkali.

For this purpose, the straw or fibrous matters are cut into short lengths, soaked in warm water, and washed; they are then placed in a suitable boiler; and I use for such purpose a rotary boiler. provided with a coil or coils of steam pipe for the purpose of heating the contents, and I prefer that the boiling should be carried on at a temperature to produce at or above 80 lbs. on the square inch, in the boiler where are the fibrous materials to be acted upon. But so high a temperature is not absolutely necessary. For I have found, by experiment, that it is essential that a temperature equivalent to seventy pounds on the square inch must be employed. The quantity of alkali used is at the rate of about 16 per cent. of caustic soda or potash, of the straw or fibrous substance under process. The
69 fibres may then be bleached by the use of a comparatively small quantity of bleaching powder or chloride of lime.

To enable others skilled in the art to make and use my invention, I will proceed to describe more fully the manner of using the same.

The straw or other fibrous materials requiring a like process to prepare the same for the paper manufacturing is first, as heretofore, to be cut in a chaff-cutting or other machine, into short lengths, and to be freed from knots, dirt, or dust, and then steeped for a few hours in hot water. The straw or fibrous matertals, and a weak solution of caustic alkali, are then to be placed in a suitable close boiler, heated by steam as hereafter explained, and the heat is to be raised to such a degree as to attain and maintain for a time a pressure internally of the boiler equal to or exceeding seventy pounds on the square inch, that is, about 310 degrees of Fahrenheit, by which means a considerable saving of alkali, as well as time and fuel, results, as compared with the means of using a hot solution of caustic alkali, as now practiced in preparing straw and other fibres for paper makers.

The boiler employed for the purpose, and the manner of heating it by steam, may be varied, but first it must have a rotary motion either on its long or on its small axis, by means which are very well known; and secondly, I prefer not to send the steam directly into the liquid in which the materials are immersed, but to pass it either in a jacket around the boiler, or through a coil or a system of steam pipes inside of it, so that the steam does not mix with the caustic alkaline solution in the middle portion of the boiler, but is kept separate, and does not, therefore, in condensing, dilute the caustic alkaline solution used.

The plan of construction of the boiler I would recommend would be, if the boiler is to rotate vertically or on its small axis, as very well known, to cover it with a jacket, so that the steam could circulate from one end to the other between the two plates, or rather, if it is to revolve horizontally or upon its long axis, as is equally very well known, to fix near each end of the boiler, and inside of it, a diaphragm or partition, which partitions are connected together by numerous tubes, which are arranged in a circle near the outer circumference of each partition.

By this arrangement the steam is introduced through the hollow axis at one end of the boiler, and it passes through the steam pipes, and thence into the compartment at the other end of the boiler, where it and the condensed steam are conveyed away, as is understood, through the other hollow axis. In adopting the plans of not sending directly the steam into the boiler, I found the three following advantages:

1st. Not to dilute, as I have already said, the alkaline solution.

2d. To avoid the trouble of having sometimes the end of the steam pipe in the boiler choked with straw, and to prevent, in case that by one cause or another the pressure in the steam boiler would fall under the degrees of the pressure in the straw boiler, the pressing of the first by the second, viz.: the absorption of straw and alkaline solution from the straw boiler into the steam boiler.

3d. The greatest facility for cooling the straw boiler when the pressure has been maintained for a sufficient length of time, by means of turning off the steam at one end, letting it at the other end out of the jacket, or of the coils or steam pipes just described, and passing through the same a stream of cold water, which, at the same time that it cools the mass, furnishes a quantity of warm water, which can be received in convenient vessels, and will be found very useful for washing the straw or ether fibrous materials, after boiling.

By means of submitting the straw or similar fibrous materials to the pressure of between 70 and 84 pounds on the square inch inside of the boiler, I can reduce considerably the proportion of alkali, and the solution which I prefer to use is to be from two or three degrees of Baume, or of a specific gravity of from 1.013 to 1.020, and at the rate of about 70 gallons of such solution to each cwt. of straw or other fibrous vegetable matter requiring like treatment.

The boiler is to be filled with straw and alkaline solution, and then closed fluid and steam tight.

The boiler is made to revolve slowly, say about one or two revolutions per minute, and the steam is to be admitted. I find it desirable to keep up the heat and pressure during about three hours after the pressure above mentioned has been obtained, when the process of boiling is complete. A steam gauge properly fixed upon the boiler will enable one to ascertain when the pressure has attained the required degree.

When the apparatus and the fibres under process have been cooled by the means hereinbefore mentioned, or rather when the pressure has been reduced to nothing, I open the man-hole of the boiler, empty the materials in suitable vessels, and wash them, first with hot water, then with cold water, until the liquor runs perfectly clear. I then steep the fibres for about an hour in hot water acidulated with a quantity of sulphuric acid, equal to about two per cent. of the weight of the fibres under process, and finally the washing is completed with cold water.

The straw or fibre may then be bleached in the ordinary manner, and it will be found to be accomplished by a comparatively small quantity of chloride of lime.

Having thus described the nature of my said invention, and the manner of performing the same, I would have it understood that I do not claim the general use of caustic alkaline solution, nor the employment generally of a close boiler for boiling straw, or other vegetable fibrous substances.

But what I claim as my invention, and desire to secure by letters patent, is the use of a solution of caustic soda (Na°,) in a compartment of a rotary vessel, separate from that which contains the steam heat, substantially as described.

I also claim the within described process for bleaching straw, consisting in boiling it in a solution of pure caustic soda (Na°,) from 2 to 3 degrees Baume, at a temperature of not less than 310 degrees Fahrenheit, after it has been soaked and cleansed, and before submitting it to the action of a solution of chloride of lime, from 1 to $1\frac{1}{2}$ degrees, substantially as described.

72 *Decree.*

At a special term of the Circuit Court of the United States of America, for the northern district of New York, in the second circuit, held at the clerk's office, in Utica, on Wednesday, the 25th day of March, in the year of our Lord one thousand eight hundred and sixty-three. Present—the Honorable Nathan K. Hall, judge.

COE S. BUCHANAN
vs.
GARDNER, HOWLAND AND JOSEPH B. PALSER. } In Equity.

This cause having been duly noticed for argument at the last stated term of this Court, and the same having been heretofore brought on for argument on pleadings and proofs, and fully argued by Messrs. Tiffany and Keller for the plaintiff, and Messrs. Gale and

The boiler employed for the purpose, and the manner of heating it by steam, may be varied, but first it must have a rotary motion either on its long or on its small axis, by means which are very well known; and secondly, I prefer not to send the steam directly into the liquid in which the materials are immersed, but to pass it either in a jacket around the boiler, or through a coil or a system of steam pipes inside of it, so that the steam does not mix with the caustic alkaline solution in the middle portion of the boiler, but is kept separate, and does not, therefore, in condensing, dilute the caustic alkaline solution used.

The plan of construction of the boiler I would recommend would be, if the boiler is to rotate vertically or on its small axis, as very well known, to cover it with a jacket, so that the steam could circulate from one end to the other between the two plates, or rather, if it is to revolve horizontally or upon its long axis, as is equally very well known, to fix near each end of the boiler, and inside of it, a diaphragm or partition, which partitions are connected together by numerous tubes, which are arranged in a circle near the outer circumference of each partition.

By this arrangement the steam is introduced through the hollow axis at one end of the boiler, and it passes through the steam pipes, and thence into the compartment at the other end of the boiler, where it and the condensed steam are conveyed away, as is understood, through the other hollow axis. In adopting the plans of not sending directly the steam into the boiler, I found the three following advantages:

1st. Not to dilute, as I have already said, the alkaline solution.

2d. To avoid the trouble of having sometimes the end of the steam pipe in the boiler choked with straw, and to prevent, in case that by one cause or another the pressure in the steam boiler would fall under the degrees of the pressure in the straw boiler, the pressing of the first by the second, viz.: the absorption of straw and alkaline solution from the straw boiler into the steam boiler.

3d. The greatest facility for cooling the straw boiler when the pressure has been maintained for a sufficient length of time, by means of turning off the steam at one end, letting it at the other end out of the jacket, or of the coils or steam pipes just described, and passing through the same a stream of cold water, which, at the same time that it cools the mass, furnishes a quantity of warm water, which can be received in convenient vessels, and will be found very useful for washing the straw or ether fibrous materials, after boiling.

By means of submitting the straw or similar fibrous materials to the pressure of between 70 and 84 pounds on the square inch inside of the boiler, I can reduce considerably the proportion of alkali, and the solution which I prefer to use is to be from two or three degrees of Baume, or of a specific gravity of from 1.013 to 1.020, and at the rate of about 70 gallons of such solution to each cwt. of straw or other fibrous vegetable matter requiring like treatment.

The boiler is to be filled with straw and alkaline solution, and then closed fluid and steam tight.

The boiler is made to revolve slowly, say about one or two revolutions per minute, and the steam is to be admitted. I find it desirable to keep up the heat and pressure during about three hours after the pressure above mentioned has been obtained, when the process of boiling is complete. A steam gauge properly fixed upon the boiler will enable one to ascertain when the pressure has attained the required degree.

When the apparatus and the fibres under process have been cooled by the means hereinbefore mentioned, or rather when the pressure has been reduced to nothing, I open the man-hole of the boiler, empty the materials in suitable vessels, and wash them, first with hot water, then with cold water, until the liquor runs perfectly clear. I then steep the fibres for about an hour in hot water acidulated with a quantity of sulphuric acid, equal to about two per cent. of the weight of the fibres under process, and finally the washing is completed with cold water.

The straw or fibre may then be bleached in the ordinary manner, and it will be found to be accomplished by a comparatively small quantity of chloride of lime.

Having thus described the nature of my said invention, and the manner of performing the same, I would have it understood that I do not claim the general use of caustic alkaline solution, nor the employment generally of a close boiler for boiling straw, or other vegetable fibrous substances.

But what I claim as my invention, and desire to secure by letters patent, is the use of a solution of caustic soda (Na°,) in a compartment of a rotary vessel, separate from that which contains the steam heat, substantially as described.

I also claim the within described process for bleaching straw, consisting in boiling it in a solution of pure caustic soda (Na°,) from 2 to 3 degrees Baume, at a temperature of not less than 310 degrees Fahrenheit, after it has been soaked and cleansed, and before submitting it to the action of a solution of chloride of lime, from 1 to $1\frac{1}{2}$ degrees, substantially as described.

72 *Decree.*

At a special term of the Circuit Court of the United States of America, for the northern district of New York, in the second circuit, held at the clerk's office, in Utica, on Wednesday, the 25th day of March, in the year of our Lord one thousand eight hundred and sixty-three. Present—the Honorable Nathan K. Hall, judge.

COE S. BUCHANAN
vs.
GARDNER, HOWLAND AND JOSEPH B. PALSER. } In Equity.

This cause having been duly noticed for argument at the last stated term of this Court, and the same having been heretofore brought on for argument on pleadings and proofs, and fully argued by Messrs. Tiffany and Keller for the plaintiff, and Messrs. Gale and

Beach for the defendants, and due deliberation thereon had; it is now ordered, adjudged, determined and decreed, and this Court, by virtue of the power and authority therein vested, doth order, adjudge, determine, and decree that the patent referred to in plaintiff's bill, granted by the United States to Marie Amédee, Charles Mellier, of Paris, France, for an improvement in making paper pulp, and bearing date the 20th day of May, 1857, is a good and valid patent; that the said Mellier was the first and original inventor of the process or processes thereby patented; that the said plaintiff, at the time of the commencement of this suit, was the assignee and legal owner of such patent, as alleged and set forth in said plaintiff's bill in this suit; that the said defendants, and each of them, have used the process claimed in the second claim of the said patent without an existing license or legal authority therefor, and have thereby violated and infringed the exclusive rights secured to the said Mellier
73 by the patent aforesaid, and held and owned by the said plaintiff as the assignee and owner thereof; and that said plaintiff is entitled to a permanent injunction, and an account of the use of such inventions, and of the gains and profits of such use made by the said defendants, and each of them, and to a decree of this Court for the payment of such profits and gains, and of the plaintiff's costs in this suit by the said defendants to the said plaintiff.

And this court doth further order, adjudge, determine, and decree that it be referred to Augustus A. Boyce, esq., of Utica, one of the masters of this court, to take and state on account of such use, gains, and profits, and to report the same to this court with all convenient speed, and that on the coming in and confirmation of his report the said defendants pay to the said plaintiff the amount of such gains and profits so reported, and, also, his the said plaintiff's costs in this suit, to be taxed, and that the said plaintiff have execution therefor.

And this court doth further order, adjudge, determine, and decree that a permanent injunction issue out of and under the seal of this court, directed to the said defendants, their servants and workmen, restraining and enjoining them and each of them from the further violation or infringement in any part or in any manner whatsoever of the said letters patent of the United States, so granted to the said Mellier, and dated the 26th day of May, 1857, and so assigned to the said plaintiff, and especially from the use of the process and mode of operation particularly described in the specification annexed to said letters and embraced in the second claim contained in such specification.

And all other questions are reserved until the coming in and confirmation of the said master's report.

N. K. HALL.

74 *Order staying injunction.*

At a special term of the Circuit Court of the United States of America, for the northern district of New York, in the second cir-

cuit, held at the Clerk's office, in Utica, on Saturday, the 25th day of April, in the year of our Lord one thousand eight hundred and sixty-three.

Present, the Honorable Nathan K. Hall, judge.

COE S. BUCHANAN
vs.
GARDNER HOWLAND and JOSEPH B. PALSER. } In Equity.

On reading and filing affidavits and notice of motion for a stay of injunction in this cause, and also affidavits in opposition thereto, and after hearing Mr. John B. Gale, of counsel for the defendants, and Mr. J. Tiffany, of counsel for the plaintiff, it is hereby ordered, that the injunction heretofore issued in this cause (and stayed and suspended by an order of one of the judges of this court, to allow this motion to be heard,) be further stayed and suspended until the further order of this court, or until the hearing and decision of this cause upon the appeal heretofore taken therein, in case such appeal shall be held to be well and properly taken from the decree heretofore made by this court in this cause; or if said appeal shall be held by the Supreme Court of the United States to have been prematurely taken, then that such injunction be stayed and suspended until the expiration of twenty days after the report of the master or commissioner under the order of reference directed by the decree of this court in this cause shall be confirmed by the order or decree of this court, or under the general rules and practice of this court in equity cases, and if another and proper appeal to the Supreme
75 Court of the United States shall then be taken to the final decree in this cause within ten days after the said master's or commissioner's report shall stand or be confirmed, then the said injunction shall be stayed and suspended until ten days after the decision of the said Supreme Court on the said appeal; provided that this order shall be void and of no effect, unless the defendants, within twenty days after the entry of this order, shall file with the clerk of this court their bond in the penalty of ten thousand dollars, with two sufficient sureties, who shall make affidavit that they are respectively worth the sum of ten thousand dollars each over and above all their debts and liabilities, conditioned to pay to said plaintiff all damages which he may sustain or in any way suffer or be entitled to by reason of any infringement of the patent under which the plaintiff prosecutes in this suit, or of his rights as finally determined and established in this cause, and, also, unless the defendants shall, within the twenty days next preceding the expiration of every period of four months after the entry of this order, file a new bond, bearing date within said twenty days, with like penalty, sureties, and conditions. And the said plaintiff is to be at liberty to apply to this court, or any judge thereof, in vacation, for a modification or discharge of this order, or for further or better security, if he shall deem it expedient to do so.

N. K. HALL.

U. S. OF AMERICA, *Northern District of New York:*

I, Augustus A. Boyce, clerk of the Circuit Court of the United States in and for the northern district of New York, do hereby certify that the foregoing is a true and correct copy of an order as entered in my office, this 25th day of April, A. D. 1863.

In testimony whereof, I have hereunto affixed the seal of this court, and have hereunto subscribed my name, this above-mentioned date.

[L. S.] A. A. BOYCE, *Clerk.*

76 *Exhibit "I."*

Know all men by these presents that I, Coe S. Buchanan, of the city, county, and State of New York, in consideration of the sum of one dollar and other valuable considerations, received to my full satisfaction of Bejamin Buffum, of the city and county of Providence, State of Rhode Island, trustee for the American Wood Paper Company, do hereby bargain, sell, assign, transfer, and convey unto said Benjamin Buffum, trustee as aforesaid, and to said American Wood Paper Company, their successors and assigns, all my right, title, and interest in and to letters patent of the United States, originally granted to Marie Amedee Charles Mellier, of Paris, dated May 26th, A. D. 1857, ante-dated August 7th, A. D. 1854, by said Mellier assigned to me through Victor Beaumont, his attorney, on the 19th day of June, A. D. 1857, which letters patent are entitled, "for improvement in the manufacture of paper pulp," my said right, title, and interest in said original letters patent, and in and to the invention therein described, being the entire title therein and thereto; to have and to hold the said original letters patent to the said Benjamin Buffum, trustee as aforesaid, and to said American Wood Paper Company, their successors and assigns, with all rights and privileges incident thereto or growing out of the same, and all claims for damages or profits against all infringers of said letters patent for and during the period from the date of said letters patent till the expiration of the term for which said letters patent were originally granted, and for such other terms or periods as said letters patent may be renewed or extended. And for the consideration aforesaid, I do hereby covenant with the said Benjamin Buffum, trustee as aforesaid, and with the said American Wood Paper Company, their successors and assigns, that, at the proper time, the personal representatives of the said Marie Amedee Charles Mellier will apply to the Commissioner of Patents of the United States for an extension of said letters
77 patent as issued, and that they will prepare, as required by law of applicants for extension of letters patent, the accounts and all other statements, and papers necessary for obtaining the same, and that they shall and will do everything necessary and proper for securing the success of such application; and that if such extension shall be obtained, that they and myself will immediately thereupon transfer and assign said extended patent to the said American Wood Paper Company, their successors and assigns, without further consideration, it being understood that said company shall

pay all necessary expenses of procuring such extension, at the Patent Office, after proper application therefor, and accounts properly verified, shall have been placed in the hands of the proper officers of said company; and I do further covenant with said Buffum, trustee as aforesaid, and with said American Wood Paper Company, their successors and assigns, that I will give my personal services for a reasonable compensation in all matters relating to the sustaining the validity of said letters patent as issued. And for myself, and on behalf of the said patentee, and his legal and personal representatives as aforesaid, under the power and authority as aforesaid, I do hereby constitute and appoint the said Benjamin Buffum, trustee as aforesaid, and the said American Wood Paper Company, their successors and assigns, the true and lawful attorney and attorneys of the said Marie Amedee Charles Mellier, and of his legal and personal representatives, and of myself, as his assignee, to claim, demand, sue for, and recover to their use, any and all damages or profits to which they the said patentees, or their legal and personal representatives, or myself, may be entitled for infringements of said letters patent, the same being done without expense to me.

Provided, however, that all damages or profits which may be recovered for infringements prior to the date of this conveyance shall be accounted for and paid over to me the said Buchanan, upon my paying my pro rata share of the expenses of the litigation in which the same may be recovered; and in case any settlement shall be made by said company for such past damages and profits without litigation, it shall be made with the assent of me, the said Buchanan; and if not satisfactory to me, I reserve the privilege of pros-

78 cuting said claims for my own benefit, at my own expense.

In testimony whereof,. I have hereunto set my hand and seal this 14th day of October, A. D. 1863.

[L. S.] C. S. BUCHANAN.

Executed and delivered in presence of—

FRED. S. VANDERPOOL.

F. R. TAYLOR.

U. S. PATENT OFFICE.

Received and recorded October 23d, 1863, in Liber D 7, page 118, of Transfers of Patents.

In testimony whereof, I have caused the seal of the Patent Office to be hereunto affixed.

D. P. HALLOWAY,
Comm'r of Patents.

79 *Exhibit "K."*

Whereas, Coe S. Buchanan, of the city, county, and State of New York, by instrument in writing, bearing date the fourteenth day of October, A. D. eighteen hundred and sixty-three, conveyed to Benjamin Buffum, of the city and county of Providence, State of Rhode

Island, as trustee for the American Wood Paper Company, all his right, title, and interest in and to letters patent of the United States originally granted to Marie Amedee Charles Mellier, of Paris, dated May 26th, A. D. 1857, ante-dated August 7th, 1854, by said Mellier, assigned to him through Victor Beaumont, his attorney, on the 19th day of June, A. D. 1857, which letrers patent are entitled, "For improvement in the manufacture of paper pulp," his said right, title, and interest in said original letters patent, and in and to the invention therein described, being the entire title therein and thereto:

Now, therefore, I, the said Benjamin Buffum, in consideration of one dollar, and other valuable considerations, received to my full satisfaction from said American Wood Paper Company, a corporation created by the general assembly of the State of Rhode Island, do hereby transfer and convey unto said corporation, their successors and assigns, all the right, title, and interest in said letters patent, and in the invention therein described, conveyed to me as trustee by the instrument aforesaid, and I do hereby substitute the aforesaid American Wood Paper Company, their successors and assigns, to all powers, rights, and privileges granted to me by the instrument aforesaid, and secured to me by the covenants therein contained and set forth.

In testimony whereof, I have hereunto set my hand and seal this sixteenth day of June, A. D. eighteen hundred and sixty-five.

(Signed) BENJAMIN BUFFUM.

Executed and delivered in presence of—
ALFRED K. HALL.
ALFRED R. KING.

80
81 *Exhibit "L'."—No.* 25,418.

THE UNITED STATES OF AMERICA.

To all to whom these letters patent shall come:

Whereas, Morris L. Keen, of Rogers' Ford, Pennsylvania, has alleged that he has invented a new and useful improvement in boilers for making pulp from wood, which he states has not been known or used before his application; has made oath that he is a citizen of the United States; that he does verily believe that he is the original and first inventor or discoverer of the said improvement, and that the same hath not, to the best of his knowledge and belief, been previously known or used; has paid into the Treasury of the United States the sum of two dollars, and presented a petition to the Commissioner of Patents, signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose.

These are, therefore, to grant, according to law, to the said Morris L. Keen, his heirs, administrators, or assigns, for the term of fourteen years, from the thirteenth day of September, one thousand eight hundred and fifty-nine, the full and exclusive right and liberty

making, constructing, using, and vending to others to be used, the id improvement, a description whereof is given in the words of the d Morris L. Keen, in the schedule hereunto annexed, and is made part of these presents,

In testimony whereof, I have caused these letters to be made patnt, and the seal of the Patent Office has been hereunto affixed.

Given under my hand, at the city of Washington, this thirteenth y of September, in the year of our Lord one thousand eight hunred and fifty-nine, and of the independence of the United States of merica the eighty-fourth.

(Signed) JACOB THOMPSON,
Secretary of the Interior.

Countersigned and sealed with the seal of the Patent Office.

(Signed) S. T. SHUGERT,
Acting Commissioner of Patents.

*(Here follows map marked page 81.

82 *The schedule referred to in these letters patent and making part of the same.*

To all whom it may concern:

Be it known, that I, Morris L. Keen, of Roger's Ford, in the county of Montgomery, and State of Pennsylvania, have invented certain new and useful improvements in boilers for boiling wood or ligneous materials for making paper pulp under pressure, and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the accompanying drawings, in which—

Fig. 1 represents a perspective view of said boiler.

Fig. 2 represents a vertical central section through the same.

My invention relates to the construction of a boiler for boiling wood and ligneous materials for making paper pulp, in which proper provision is made for keeping the stock covered by the alkali or liquid used, and giving it motion to eusure the mass being properly boiled throughout, and a discharge valve or cock, by means of which the stock when sufficiently boiled, is blown out in a pulpy state.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation.

A represents a vertical cylindrical boiler, which is mounted on supports B, or on any other suitable frame. The upper part of the boiler is made conical, and is provided with an expansion chamber C, through the aperture of which the boiler is charged, and which is closed by a cover D, which is bolted steam tight to the same. The bottom of the boiler A is made funnel shapped, and ends in the centre in the discharge pipe E, which is closed by a piston or stop-cock G. The latter is secured to the rod H and can be opened or closed by means of the hand wheel F of the rod H, which passes through the stuffing-box I, and has its lower bearing on the bracket *a*. K re-

presents two stirrers, the shafts of which run at their lower ends in the steps *b*, while their upper ends pass through the stuffing-boxes L, and are provided with pinions M, which are driven by
83 suitable gearing. The shafts of the stirrers K are provided on one side only with the horizontal stirring arms, which, when the boiler is to be charged, and turned towards the periphery of the boiler, and are therefore not in the way of the material as it is thrown into the boiler; *d* represents a perforated plate, which is secured to the rod N, and which rests on the brackets *g* of the expansion chamber C; it is intended to press the material down and to keep it submerged in the fluid in which it is to be boiled. The plate *d* is prevented from rising by the upper end of the rod N, being in contact with the lower face of the cover D. O represents try-cocks, by which the material in the boiler can be tried, to what degree of perfection the stock is worked.

The operation is as follows:

The boiler being charged with the proper solution of caustic alkali or other suitable fluid, and with the material which is to be reduced to pulp, the plate *d* is placed upon it and the cover G is screwed down tightly. The boiler A is then heated, either by a direct fire or by any other heating apparatus, and the mass in the boiler is boiled and stirred until thoroughly disintegrated. During this process the steam arising from the fluid rises through the perforated plate *d*, and fills the expansion chamber C, whence it exerts a pressure upon the boiling mass in the boiler.

When the stock has been reduced to the desired perfection, the stop-cock G is opened by means of the hand-wheel E, and the entire mass is blown by the pressure of the steam in the expansion chamber and boiler through the pipe E, as a pulp, into an open tank adjacent to the boiler A. The expansion chamber C may be provided with a pipe leading to a steam gauge, to indicate the pressure of steam in the boiler.

Having thus described my invention, what I claim is a boiler for boiling under pressure wood and ligneous materials for making paper pulp, constructed with an expansion chamber, stirrers, and discharge valve or cock, arranged for the purposes and in the manner substantially as herein stated.

(Signed) MORRIS L. KEEN.

Witnesses—

EPHRAIM MILLER,
HUGH BURGESS.

84 *Exhibit "M'."*

Know all men by these presents that I, Morris L. Keen, of Rogers' Ford, Montgomery county, and State of Pennsylvania, in consideration of the sum of one dollar and other valuable considerations, received to my full satisfaction, of Benjamin Buffum, of the city and county of Providence, and State of Rhode Island, trustee for the American Wood Paper Company, do hereby grant, bargain, and sell to said

Buffum, trustee as aforesaid, an absolute and exclusive license to use my invention in boilers for making paper pulp from wood, for which letters patent of the United States were granted to me on the thirteenth day of December, A. D. 1859, in the manufacture of paper pulp as aforesaid, within and throughout the United States of America, for the full term for which said letters patent are granted, and during any extension or renewal thereof. To have and to hold the same to him, the said Buffum, for the benefit of said Wood Paper Company, and to said company, their successors and assigns, for and during the period or periods aforesaid. And I do hereby covenant with said Buffum, trustee as aforesaid, and with said American Wood Paper Company, their successors and assigns, that I have heretofore made no conveyance, grant, assignment, or license of my said patent, or any interest in the same, or right to use my said invention, which will interfere with this grant of an exclusive license for the purposes aforesaid, or which will impair the value of the same, and also that I will hereafter make no grant, conveyance, assignment, or license, nor under said patent or the right to use said invention which will conflict with or impair the value of the exclusive license herein granted for the purposes aforesaid. And I do hereby further covenant and agree with said Buffum, trustee as aforesaid, and with said American Wood Paper Company, their successors and assigns, that I will make conveyance to him or them of an absolute and exclusive license to use any and all improvements which I have made or which I may hereafter make upon my said patented invention, to be used for the purposes aforesaid, throughout the United States of America, for the full term for which any letters patent for any such improvement may be granted. And I do further hereby
85 covenant and agree with said Buffum, trustee as aforesaid, and with said American Wood Paper Company, their successors and assigns, that I will make application in due time, under the law, for an extension of said letters patent, and use all proper and lawful means and diligence for procuring the same, for the benefit of said company, such application and the proceedings necessary to to secure such extension being conducted at their expense. And I do hereby constitute and appoint the said Buffum, trustee as aforesaid, and the said American Wood Paper Company, their successors and assigns, my true and lawful attorney and attorneys irrevocable, to claim, demand, sue for, and recover, to his and their use, any and all claims for damages and profits arising from the infringment of my patented inventions, for which I have herein granted, and may hereafter grant licenses, for the exclusive use as aforesaid to him or them, such claim being prosecuted without expense to me, and to use my name in any and all suits or proceedings in which it may be necessary to use the same for the protection of the rights herein granted and covenanted to be granted. And I do further covenant with said parties, that I will execute any other instrument or instruments for the further assurance of the title hereby granted that may be required to perfect the same, and secure to said parties all the remedies which they may have in law and equity for the protection of their rights.

In testimony whereof, I have hereunto set my hand and seal this the eighteenth day of May, A. D. eighteen hundred and sixty-three.

(Signed) MORRIS L. KEEN.

Executed and delivered in presence of—

JOHN FARRELL,
WM. GOODWIN.

U. S. PATENT OFFICE.

Received and recorded Oct. 23, 1863, in Liber D 7, page 111, of Transfers of Patents.

In testimony whereof, I have caused the seal of the Patent Office to be hereunto affixed.

D. P. HOLLOWAY,
Comm'r of Patents.

86 *Exhibit "N'."—No.* 38,901.

THE UNITED STATES OF AMERICA.

To all to whom these letters patent shall come:

Whereas, Morris L. Keen, of Rogers' Ford, Pennsylvania, has alleged that he has invented a new and useful improved boiler for making paper pulp, which he states has not been known or used before his application; has made oath that he is a citizen of the United States; that he does verily believe that he is the original discoverer of the said invention, and that the same hath not, to the best of his knowledge and belief, been previously known or used; has paid into the Treasury of the United States the sum of thirty-five dollars, and presented a petition to the Commissioner of Patents, signifying a desire of obtaining an exclusive property in the said invention, and praying that a patent may be granted for that purpose.

These are, therefore, to grant, according to law, to the said Morris L. Keen, his heirs, administrators or assigns, for the term of seventeen years from the sixteenth day of June, one thousand eight hundred and sixty three, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said invention, a description whereof is given in the words of the said Morris L. Keen, in the schedule hereunto annexed, and is made a part of these presents.

In testimony whereof, I have caused these letters to be made patent, and the seal of the Patent Office has been hereunto affixed.

Given under my hand, at the city of Washington, this sixteenth day of June, in the year of our Lord one thousand eight hundred and sixty-three, and of the independence of the United States of America the eighty-seventh.

(Signed) W. J. OTTO,
Acting Secretary of the Interior.

Countersigned and sealed with the seal of the Patent Office.

(Signed) D. P. HOLLOWAY,
Commissioner of Patents.

[Here follows map marked page 86.]

87 *The schedule referred to in these letters patent, and making part of the same.*

To all whom it may concern:

Be it known that I, Morris L. Keen, of Rogers' Ford, in the county of Montgomery, and State of Pennsylvania, have invented certain new and useful improvements in boilers for making paper pulp; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings making a part of the specification, and which represent the boiler in elevation, with a portion of its upper part represented in section, to show the interior arrangement thereof.

In boilers where a perforated diaphragm is placed in the interior, and through which diaphragm the material out of which the pulp is to be made is to be charged into the cylinder, it is found that the material falling upon the diaphragm chokes up its openings, and, moreover, gets above or on top of the liquid, which it is the special object of the diaphragm to prevent. My object and purpose is to prevent this difficulty, and I have achieved it in a very simple manner. My invention consists in connecting the man or feed-hole in the shell of the boiler with the man or feed-hole through the diaphragm by a perforated well or cylinder, so that the material can be charged through said well into the boiler without falling upon or clogging the perforated diaphragm.

To enable others skilled in the art to make and use my invention, I will proceed to describe the same by reference to the drawings.

A represents a boiler, which stands vertically in the furnace or brick-work, and which for strength and convenience has hemispherical ends, its body being cylindrical. This boiler is suspended to the brick-work or foundation by flanges *e*, so that it may expand or contract without loosening itself from the foundation or its support.

In the interior of the boiler, near its upper end, there is placed a perforated diaphragm B, through the centre of which there is an opening *c c*, and at the top or crown of the boiler there
88 is also a man or feed-hole or opening *a a*, and these two openings *a c* are connected by a perforated well or cylinder G, to act as a guide for the material being charged into the boiler and to prevent it from falling upon the perforated diaphragm, and thus not only choking its openings, but getting on top of the liquid, which it is important to avoid as damaging to the pulp.

The openings *a c* are respectively closed after the boiler is charged by the covers *b d*, which may be secured in any of the known ways of securing man-hole covers in steam boilers. Above the perforated diaphragm B there is an expansion chamber I, into which the liquid contents of the boiler expand when the fire is applied to the boiler, whilst the perforated diaphram B keeps the crude material submerged.

E is a discharge pipe at the bottom of the boiler A, and F a stop or discharge valve for blowing out the contents of the boiler whilst under pressure, when said contents have been sufficiently boiled.

C is a steam-indicator and D a safety valve, of any of the common constructions, and instead of their being placed at the top of the boiler, they may be brought down to any convenient position or locality near the attendant, so as to be readily observed by him.

The boiler may be heated by the direct application of fire, or by any other convenient or known mode; but I prefer to make a direct application of heat, and, for this purpose, use a fire-car or truck H, on wheels, which is withdrawn when the boiler is to be discharged, and replaced immediately after the boiler is again refilled for service.

Having thus fully described the nature, object, and purpose of my invention, what I claim therein as new, and desire to secure by letters patent, is, first, a boiler provided with a perforated diaphragm and well, or their substantial equivalents, arranged in the manner and for the purpose described.

I also claim, in combination with the boiler, the arrangement of the discharge pipe and valve, for the purpose of blowing out or discharging the contents of the boiler under pressure, substantially as and for the purpose set forth.

(Signed)

MORRIS L. KEEN.

Witnesses:

JAMES THOMPSON.
ELIJAH SHARP.

89 *Exhibit "O'."*

Whereas, Morris L. Keen, of Rogers' Ford, Montgomery county, and State of Pennsylvania, by instrument in writing, bearing date eighteenth day of May, A. D. eighteen hundred and sixty-three, conveyed to Benjamin Buffum, of the city and county of Providence, State of Rhode Island, as trustee for the American Wood Paper Company, an absolute and exclusive license to use his invention in boilers for making paper pulp from wood, for which letters patent of the United States were granted to him on the thirteenth day of September, A. D. 1859, in the manufacture of paper pulp as aforesaid, within and throughout the United States of America, for the full term for which said letters patent were granted, and during any extension or renewal thereof: Now, therefore, I, the said Benjamin Buffum, in consideration of one dollar and other valuable considerations, received to my full satisfaction from said American Wood Paper Company, a corporation created by the General Assembly of the State of Rhode Island, do hereby transfer and convey unto said corporation, their successors and assigns, all the right, title, and interest in said letters patent, and in the invention therein described conveyed to me, as trustee, by the instrument aforesaid, and I do hereby substitute the aforesaid American Wood Paper Company, their successors and assigns, to all powers, rights, and privileges granted to me by the instrument aforesaid, and secured to me by the covenants therein contained and set forth.

In testimony whereof I have hereunto set my hand and seal this sixteenth day or June, A. D. eighteen hundred and sixty-five.

(Signed)

BENJAMIN BUFFUM.

Executed and delivered in presence of—

ALFRED K. HALL.

ALFRED R. KING.

90 *Exhibit "P."*

This indenture, made this eleventh day of July, A. D. 1865, by and between Morris L. Keen and the American Wood Paper Company, witnesseth: That I, Morris L. Keen, in consideration of the sum of one dollars received to my satisfaction of the American Wood Paper Company, do hereby assign and convey to them all my right, title, and interest in and to letters patent of the United States, which were granted to me on the thirteenth day of September, A.D. 1859, for my invention in boilers for making paper pulp; to have and to hold the same to the said American Wood Paper Company, their successors and assigns, for the full term for which said letters patent are granted, and for any extension thereof.

And the said American Wood Paper Company, in consideration of said conveyance, do hereby covenant with said Morris L. Keen, that they will convey to him or to such person as he may appoint, whenever he may make request therefor, a territorial or other license for the use of said inventions in the manufacture of any other article than paper pulp, and which does not come into conflict with the rights heretofore granted by said Keen to Benjamin Buffum for the use of said company, by instrument dated May 18th, 1863, and will reconvey to said Keen the title hereby acquired, whenever it can be done without injury to the right of said company to sue for or recover for infringements, and without impairing the exclusive rights they now hold under said patents.

In testimony whereof, the said parties have hereunto set their hands and seals, the said company by B. Buffman, their treasurer, this eleventh day of July, A. D. 1865.

[SEAL.] MORRIS L. KEEN.

AMERICAN WOOD PAPER CO.

[CORPORATE SEAL.] By B. BUFFMAN, *Treas.*

Executed in presence of—

JOHN RANDOLPH,

ALFRED K. HALL,

Witness to signature of B. Buffman.

(50-cent stamp)
(5-cent stamp.)

91 UNITED STATES OF AMERICA, *District of Rhode Island, ss.:*

On the twenty-fourth day of August, A. D. 1865, before me, came Benjamin Buffum, one of parties interested in said bill of complaint, and who has signed the same in his capacity as treasurer of the

American Wood Paper Company, and he being by me duly affirmed, did depose and say: That he had heard the said bill read, and knew the contents thereof, and that the same was true of his own knowledge, except as to the matters which are therein stated on information and belief, and that as to those matters he believed to be true.

And the said Benjamin Buffum did further depose and say, that he did verily believe that the said Charles Watt and Hugh Burgess were the original and first inventors of the inventions and improvements described and claimed in Schedules A and B in said bill named, as annexed to the reissued letter patent therein set forth, and copies of which are annexed in said Schedules A and B.

And the said Benjamin Buffum did further depose and say, that he did verily believe that Marie Amedee Charles Mellier was the original and first inventor of the invention and improvement described and claimed in Schedule E in said bill named, and annexed to the letters patent therein set forth, a copy of which is annexed in said Schedule E, for a new and useful improvement in making paper pulp.

And the said Benjamin Buffum did further depose and say, that he did verily believe that Morris L. Keen was the original and first inventor of the inventions and improvements described and claimed in Schedules L and M in said bill named, as annexed to the letters patent therein set forth, copies of which are annexed in Schedules L and M.

JAMES H. PARSONS,
United States Commissioner for said District.

92 UNITED STATES OF AMERICA, *Eastern District of Pennsylvania, ss:*

I, Hugh Burgess, now residing at Royer's Ford, Montgomery county, and State of Pennsylvania, on oath depose and say, that I verily believe that Charles Watt and myself were the original and first inventors of the inventions and improvements described and claimed in Schedules A and B in said bill named, as annexed to the reissued letters patent therein set forth, copies of which are annexed in said Schedules A and B, one for a pulp suitable for the manufacture of paper, made from wood or other vegetable substances, and one for the process of treating wood and other vegetable substances in the manufacture of paper pulp.

HUGH BURGESS.

Subscribed and sworn to this twenty-ninth day of August, A. D. 1865, before me—

W. GRIER HIBLER,
U. S. Commissioner for said district.

93 UNITED STATES OF AMERICA, *Eastern District of Pennsylvania, ss:*

I, Morris L. Keen, Royer's Ford, Montgomery county, and State of Pennsylvania, on oath depose and say, that I verily believe that I was the original and first inventor of the inventions and improvements described and claimed in Schedules L and M, in said bill named as annexed to the letters patent, therein set forth, copies of which

are annexed in said Schedules L and M, one for an improvement in boilers for making pulp from wood, and one for an improved boiler for making pulp.

MORRIS L. KEEN.

Subscribed and sworn to this thirtieth day of August, A. D. 1865, before me,

W. GRIER HIBLER,
U. S. Commissioner for said District.

94

95 In the Circuit Court of the United States in and for the eastern district of Pennsylvania. In equity.

THE AMERICAN WOOD PAPER COMPANY
vs.
JACOB D. HEFT *et al.* } No. 20.

These defendants, by protestation, not confessing or acknowledging all or any of the matters and things in the said complainants bill to
96 be true, in such manner and forms as the same are therein set forth and alleged, demur thereto, and for cause of demurrer
97 show, that the said bill is multifarious, because it includes in it several and distinct matters of complaint which ought not to be joined in one bill, to wit, the alleged infringement of five several letters patent, which are entirely separate, distinct, and independent of each other.

The said defendants cannot from said bill ascertain which of said letters patent they are charged with infringing, so as to be able to make specific answer to such charge; and if these defendants should be compelled to make answer unto said bill, they will be put
98 to great cost and unnecessary expense; wherefore these defendants demand the judgment of this honorable court, whether they shall be compelled to make any farther or other answer to the said bill, or any of the matters and things therein contained, and pray to be hence dismissed with their reasonable costs in this behalf sustained.

GEORGE HARDING,
Att'y for Def'ts.

I hereby certify that, in my opinion, the foregoing demurer is well founded in point of law.

GEODGE HARDING, *Att'y for Def'ts.*

99 Jacob D. Heft, S. A. Rudolph, and John Dixon, defendants in the above-mentioned bill of complaint, being severally duly sworn or affirmed according to law, depose and say that the foregoing demurer is not interposed for delay.

JACOB D. HEFT.
S. A. RUDOLPH.
JOHN W. DIXON.

Sworn or affirmed and subscribed this thirteenth day of October, 1865, before me,

W. GRIER HIBLER, *U. S. Commissioner.*

100 United States Circuit Court, eastern district of Penn'a.

Defendants' answer.

AMERICAN WOOD PAPER CO.
vs.
JACOB D. HEFT, S. A. RUDOLPH, JOHN W. DIXON.

The joint and several answers of Jacob D. Heft, S. A. Rudolph, and John W. Dixon, defendants to the bill of complaint of the American Wood Paper Company, complainant.

These defendants now, and at all times hereafter, saving and reserving to themselves, and each of them, all manner of benefit and advantage of exception that can or may be had or taken to the many errors, insufficieacies, and imperfections in the said bill of complaint contained for answers thereto, or to so much thereof as they are advised it is material and necessary for them to make answer unto. answering, say: These defendants, further answering, by way of demurrer or protestation, that they hereby renew the demurrer filed heretofore by them at the October session of this court, 1865, objecting and protesting to the bill of complaint, because said bill is multifarious and includes in it several and distinct matters of complaint which ought not to be joined in one bill, viz: the alleged infringement of five several letters patent, which are separate and distinct and independent of each other, and that by being compelled to answer thereto the defendants will be put to great cost and unnecessary expense, and they pray the same benefit of the demurrer in this answer at the final hearing of the cause as if the same had been separately filed.

101 And these defendants, further answering. on information and belief, say, as to the Watt & Burgess patent and its several reissues and the alleged infringement thereof, as follows, viz:

1. That an English patent was granted to Watt & Burgess, August 19th, 1853.

2. That letters patent of the United States were granted to said Watt & Burgess for fourteen years from August 19th, 1853, purporting to be for the same invention, and re-issues purporting to be upon said original patent, were granted to the said Ladd and said Keen, bearing date October 5th, 1858, and April 7th, 1863, but that said reissues are illegal and void for reasons hereinafter mentioned.

3. That no such assignment from Charles Watt and Hugh Burgess to Frederick B. Houghton, bearing date November 22d, 1854, was made and recorded in the Patent Office as in said bill is alleged, and that for want thereof the title of said Ladd and Keen and of these complainants derived therefrom is insufficient to enable the complainants to maintain this bill of complaint under the said Watt & Burgess patent, or the said reissues to Ladd and Keen. And these defendants, answering further, say that the said Frederick B. Houghton had no right to and did not assign to said William F. Ladd and Morris L. Keen the invention secured for, to, and in the United States by the patent granted to Watt & Burgess, July 18th, 1854, as in said bill is alleged.

4. That William F. Ladd and Morris L. Keen, in said bill mentioned, on the 5th day of October, 1858, at the time of making the first surrender of the aforesaid patent, alleged in said bill, were not legally entitled to make said surrender and receive a reissue thereupon for want of sufficient title and ownership in said letters patent as hereinbefore mentioned, and that by reason thereof the said reissued patent granted to said Ladd & Keen upon said surrender was null and void.

5. These defendants, further answering, say that the said
102 surrender and reissue of October 5th, 1858, was not made for the purpose of correcting said original specification, but was made for the purpose of changing the invention described and claimed therein, and of obtaining letters patent for a different invention, and that said surrender and reissue were in this respect, fraudulent and void.

6. That at the time of making the surrender of said last-mentioned reissued letters patent, and the granting of the two second reissues, bearing date April 7th, 1863, the said Ladd and Keen, by whom said surrender was made, had no sufficient title to make said surrender for want of an assignment from Watt & Burgess; and the Commissioner of Patents had no right to grant said reissed letters patent to said Ladd & Keen by reason of the want of sufficient title in said Ladd & Keen, as hereinbefore mentioned.

7. That the surrender and reissue of said two reissued letters patent to Ladd & Keen, bearing date April 7th, 1863, was not for the purpose of amending or correcting said specification, as is in said bill alleged; but for the purpose of illegally changing the invention secured by said reissues, and was therefore illegal, fraudulent, and void.

8. That the said reissued letters patent, No. 1,448, so granted, were not granted in conformity to law, and that said reissue, No. 1,448, is not for a separate and distinct subject matter, such as to warrant a division of said reissues.

9. That the said two reissues of Ladd & Keen, No. 1,448 and 1,449, are antedated to August 19th, 1853, and that the Commissioner of Patents had authority to issue the said several reissued patents so dated, only upon the express allegation by said patentees that said reissued patents were for the same invention as had been previously patented in Great Britain, August 19th, 1853, and that said two reissued patents, No. 1,148 and 1,449, are not for the same invention as that for which the said English patent of August 19th, 1853, was granted, and that by reason of the said false suggestion, and by reason of the antedating of said ressued
103 patents to August 19th, 1853, the said reissues, No. 1,448 and 1,449, are null and void.

10. These defendants are not informed, save by said bill of complaint, and therefore cannot answer as to the truth of the alleged assignments from Ladd & Keen to Benjamin Buffum, or of Benjamin Buffum's assignment to the said complaints, and leave complainant to prove the same as he may be advised.

11. And as to said Watt & Burgess's original patent in the said bill mentioned, and the alleged reissue thereof, these defendants say that Watt & Burgess, and those claiming under them, failed and neglected to put and continue on sale to the public, on reasonable terms for the space of eighteen months from the date of said letters patent, the invention for which the patent was issued, and that by reason thereof, the said complainants are not entitled to maintain their bill of complaint as to said letters patent and the reissues thereof.

12. That the said defendants do not use, and have not used, the invention of said Watts & Burgess described and mentioned in their original letters patent of July 18th, 1854.

13. These defendants deny that the reissued letters patent of Ladd & Keen, of April 7th, 1863, No. 1,448, set forth and contain a legally patentable subject matter.

14. That the said Watt & Burgess were not the first and original inventors of the inventions described and claimed in the two reissued letters patent of April 7th, 1863, and therefore said two reissued letters patent are null and void; and for the purpose of establishing the want of novelty of said Watt & Burgess, in respect to said alleged invention, these defendants hereby notify the complainants that they will at the hearing rely upon, and they propose to give in evidence the following several patents and publications:

104 Brevet d'invention (French patent) of Clothan Breuil, February 12th, 1846, and to publication of same in description des machines et proceeds.

Pour lesquels des Brevet d'Invention, on ete puis sons le Regeme de la loi du 5 Juillet, 1844. Tome sixieme, pages 60 and following, published at Paris, 1851.

Brevet (French patent) Sieur Gros, March 20th, 1847, and to publication of same in the work last cited at length, volume 10, pp. 94 to 96, published, Paris, 1852.

Brevet (French patent) of Sieur Mege, dated June 27, 1845, and to publication of same in the book last above cited at length, volume 4, page 197, and following, published at Paris, 1849.

Brevet (French patent) Sieur Roque, dated Nov. 7th, 1845, and to publication of same in the book last cited at length, volume 5, page 209, and following, published 1850.

Brevet (French patent) La Forrest Berryer, dated Nov. 24, 1825, and to publication of same in book last cited at length, volume 43, Paris, 1841, '42; and also to book entitled Bulletin de la'Societie de l'encouragement pour l'industrie nationale Quatorzieme Annee, page 18, published at Paris, 1815.

Brevet (French patent) of Charles Wise, dated May 12th, 1838, and to the publication thereof in the book entitled Description des Machines et Procedes.

Pour lesquels des Brevets d'Invention on etc., etc., etc., volume 43, page 37 and following. Paris, 1842.

105 Brevet (French patent) Sieur Bronzac, Chaptal et D'Arcet, December 30th, 1824, and to publication thereof in book last cited, volume 41, pages 359 to 362. Paris, 1842.

Brevet (French patent) Sieur Chabert a Rouen, May 11th, 1839, and to publication thereof in book last cited in full, volume 70, page 46 and following. Paris, 1849.

Brevet Montgolfier Freres, dated February 7th, 1838, October 5, 1838, October 16th, 1838, and to the publication thereof in book last cited in full, volume 67, pages 15 to 26. Paris, 1848.

Brevet Segun, dated 1806, published in book last cited, volume 3, page 268. Paris, 1820.

Brevet Monier Legoux, March 12th, 1839, and to publication thereof in book last cited, volume 52, pages 413 and following, published at Paris, 1844.

Burlage Zeau, No. 35, Central Blattes fur deutsche, papier fabrication, No. 35, May 15, 1852, at page 15, and note on said page. Central Blatt fur deutche papier fabrication, Herausgiben.

Von Alwin Rudel, No. 27, Van Halle, a S. 815, September, 1852, pages 449 to 451, and especially 451.

Same periodical just cited of 15th December, 1852, page 499, and No. 35.

106 Industrie Aus tellung, Zu Londoh, 1851, Th II, pages 339 to 342, and especially page 342. Verhandlung des Vereinseu Befondering des Gewerbfleishes in Preussen, Berlin, 1846, Volume 25, pages 22, 28.

English patent, Lemuel W. Wright, dated 1833, June 15th, No. 7,987.

English patent of Watt & Burgess, dated August 19th, 1853.

Letters patent of the United States, Lemuel W. Wright, March 27th, 1847.

French patent granted to Lasdet, August 7th, 1854.

French patent granted Coupier & Mellier, May 7th, 2851.

Letters patent United States granted to M. A. C. Mellier, May 26, 1857.

English patent to of A. Mellier, May 2, 1865, sealed October 26, 1855.

English patent of John Jeyes, March 31st, 1854.

American patent, William Magaw, Meadville, March 8, 1828, May 22, 1828, and to the publication thereof in Journal Franklin Institute, volume 1, page 416, published 1828.

Also to Journal of Franklin Institute, volume 1, pages 9 and 93, published at Philadelphia in 1826.

Also to practical treatise on dyeing and calico printing, published by Harper & Bro., in 1846, pages 207 and 208.

Also to letters patent United States granted to George Spafford, September 27th, 1840, and to the reissued patent therefor granted to John Campbell, June 7, 1850.

Letters patent of the United States granted Theodore Coupier & M. A. Charles Mellier, August 2d, 1853, and to the re-issue of the same patent to Coe S. Buchanan.

Ce ntral Blatte fur deutsche Papier fabrication, No. 29, 15th November, 1852, page 483.

107 II.

And as to the letters patent in said bill of complaint, alleged to have been granted to Marie Amedee Charles Mellier, May 26th, A. D. 1857, these defendants answering, on information and belief, say that the said Mellier was not the first and original inventor of the said alleged improvement, or a material part thereof, but that the same was described in printed publications anterior the supposed invention thereof by said Mellier, and the said defendants hereby give notice of the following several prior patents and printed publications, viz:

Brevet d'invention (French patent) of Clothon Breuil, February 12th, 1846.

And to publication of same in Description des Machines et Procedes.

Pour lesquels des Brevet d'Invention on ete puis sons le Regeme de la loi du, 5 Juillet, 1844, Tome sixieme, pages 60 and following, published at Paris, 1851.

Brevet (French patent) Sieur Gros, March 20th, 1847, and to publication of the same in the work last cited at length, volume 10, pages 94 to 96, Paris, published 1852.

Brevet (French patent) of Sieur Megi, dated June 27th, 1845, and to publication of same in the book last above cited at length, volume 4, page 197 and following, published at Paris, 1849.

Brevet (French patent) Sieur Roque, dated Nov. 7th, 1845, and to publication of the same in the book last cited at length, volume 5, page 209 and following, published 1850.

Brevet (French patent) La Forrest Berryer, dated Nov. 14, 1825, and to publication ot same in book last cited above, volume 43, Paris, 1841–42; and also to book entitled Bulletin de la Societie de l'encouragement your l'industrie nationale Quatorxieme Anne, page 18, published at Paris, 1815.

108 Brevet (French patent) of Charles Wise, dated May 12th, 1838, and to the publication thereof in the book entitled, Description des Machines, et Procedes pour les quels, des Brevets d'invention on etc., etc-, etc., volume 43, page 37 and following, Paris, 1842.

Brevet (French patent) Sieur Bronzae, Chaptal et D'Arcet, December 30th, 1824, and to publication thereof in book last cited, volume 41, pages 359 to 362, Paris, 1842.

Brevet (French patent) Sieur Chabert a Rouen, May 11th, 1839, and to publication thereof in book last cited in full, volume 70, page 46 and following, Paris, 1849.

Brevet Montgolfier Freres, dated February 7th, 1838, October 5th, 1838, October 16th, 1838, and to the publication thereof in book last cited in full, volume 67, pages 15 to 26, Paris, 1848.

Brevet Segun, dated 1806, published book last cited, volume 3, page 268, Paris, 1820.

Brevet Monier Legoux, March 12, 1839, and to publication thereof

in book last cited, volume 52, pages 413 and following, published at Paris, 1844.

Berlage Zu No. 35. Central Blattes fur deutsche Papier-fabrication, No. 35, May 15, 1852, at page 15 and note on said page.

Central Blatt, fur deutsche Papier-fabrication, Herausgiben Von Alwin Rudel, No. 275, Van Halle a S. 815, September, 1852, pages 449 to 451, and especially 451.

Same periodical just cited of 15th December, 1852, page 499.

109 Industrie Austellung Zu London, 1851, Th II, pages 329 to 342, and especially page 342. Verhandlung des Verein's, Sur Befondering des Gewerbfleishes, in Preussen, Berlin, 1846, volume 25, pages 22, 28.

English patent, Lemuel Wright, dated 1834, June 15, No. 7,987.

English patent of Watt & Burgess, dated August 19th, 1853.

Detters patent of the United States, Lemuel W. Wright, March 27th, 1847.

French patent granted to Lasdet, August 7, 1854.

French patent granted Coupier & Mellier, May 7, 1851.

English patent of A. Mellier, May 2d, 1855, sealed October 26, 1855.

Central Blatte fur deutsche Papier fabrication, No. 29, Nov. 15th, 1852, page 483.

English patent of John Seyes, March 31st, 1854.

French patent Lasdet, August 7, 1854.

American patent, William Magan, Meadville, March 8th, 1828, May 22, 1838, and to the publication thereof in Journal Franklin Institute, volume 1, page 416, published 1828.

2. That the said letters patent granted to Marie Amedee Charles Mellier, May 26, 1857, were ante-dated to the 7th day of August, 1854, upon the suggestion that the said patent was for the same invention for which letters patent had been previously granted to said M. A. C. Mellier, in France, bearing date August 7th, 1854, and that the Commissioner of Patents only had authority to grant said letters patent, bearing said date, upon the express condition that said letters patent were for the same invention so previously
110 patented by the French government to M. A. C. Mellier, and that said letters patent of the United States are not for the same invention so previously patented, and that said letters patent are therefore null and void, and these defendants refer to the French Law of Patents in this connection.

3. That the application and specification on which said letters patent of May 26, 1857, were granted to said M. A. C. Mellier, were not sworn to by the said M. A. C. Mellier in conformity with law, and that by reason thereof the said letters patent are null, void.

4. And as to the alleged suit in equity, and decree in the Circuit

Court of the United States for the northern district of New York, of Coe S. Buchanan *vs.* Gardner, Howland & J. B. Palser, these defendants say that they have no other positive knowledge save that furnished by said bill of complaint; but they have been informed that such a suit was heard and decided about the time mentioned, and that the defendants in said suit used a materially different apparatus and process from that used by these defendents, and that upon the questions of novelty, originality and the prior state of the art, as affects the said patent of Mellier, the publications and patents herein mentioned were not cited or put in evidence by the defendants, and were not known to the court at the time of making the said decree, and that such evidence would have materially affected the decree in the former suit.

5. The said letters patent of the said M. A. C. Mellier are for the same invention as the two reissued letters patent of Ladd & Keen, of April 7th, 1863, antedated to August 19th, 1853, and therefore said letters patent of said M. A. C. Mellier are null and void.

6. That these defendants are not informed, save by said bill of complaint, whether the said several assignments of said Mellier to Coe S. Buchanan, or Coe S. Buchanan to Benjamin Buffum, or of Benjamin Buffum to the complainant, as set forth in said bill of complaint, were duly made and recorded as in said bill is alleged,
111 and leave the complainant to prove the same as he may be advised, if he shall deem the same to be material.

III.

1. And as to the letters patent, dated September 13, A. D. 1859, to Morris L. Keen, in said bill mentioned, these defendants allege that the said Morris L. Keen was not the original and first inventor of the improvement described in said letters patent; but that the said invention, or a material part thereof, had been described in printed publications, and patented by others anterior to the alleged invention by said Keen, and by reason thereof said letters patent are null and void; and these defendants hereby give notice of the following prior patents and printed publications, as containing a description of said invention, or a material part thereof:

Fubrication de Papier, by Piettes, published in 1861, page 21. Verhandling des Verems sui Befondering des Gewertfleisches, in Preussen, published at Berlin, 1846, volume 25, page 228. Fabrication de Papier, Dr. L. Muller, second edition, published at Berlin, 1855, page 32 and fig. 1.

Lemuel Wright, English patent, 1843. June 15, No. 7,987.

Lemuel Wright, patent U. S. 1847, Journal des Fabricats de Papier, volume 5, page 34, figures 29 and 30, published at Paris and Arden, Nov., 1858.

Central Blatte fur deutsche papier fabrication, No. 29, 15th November, 1852, page 483.

2. These defendants, further answering, say that the said alleged patented invention of said Keen, or a material part thereof, is

112 discharged and contained in the reissued letters patent of Ladd & Keen, dated April 7th, 1863, antedated August 19th, 1853, hereinbefore mentioned, and that by reason thereof said letters patent of said Keen, of September 13, 1859, are null and void.

3. These defendants further deny that they, or either of them, have any knowledge of either of the several assignments in said bill mentioned of Morris L. Keen to Benjamin Buffum, or of Benjamin Buffum to the complainants, and they leave the complainants to prove the same as they may be advised.

4. These defendants, further answering, allege that said letters patent do not disclose a practically useful invention or improvement; and they further say, that said improvement was never introduced into practical use, and that by reason thereof said complainants are not entitled to any relief in equity under said letters patent.

IV.

1. As to the letters patent in said bill of complaint alleged to have been granted to Morris L. Keen, June 16, 1863, these defendants say they have no knowledge as to the several facts in said bill mentioned as preceding the issue of said letters patent, nor as to the correctness of the alleged copy of said patent annexed to said bill of complaint, and therefore leave the complainant to prove the same, but they are informed and admit, that letters patent, bearing the aforesaid date, were granted to said Keen.

2. These defendants, answering, say, and expect to prove, that the said Keen was not the original and first inventor of the improvement described and patented in said last-named letters patent, but that the same, or a material part thereof, was described in prior patents and publications, and that by reason thereof said letters patent are null and void; and the defendants hereby give notice that on the hearing of this case they will, in order to maintain this averment and to establish the prior state of the art, refer

113 to the following prior patents and printed publications respectively:

Fabrication de papier, by Piettes, published in 1861, page 21.

Verhandling des Verein's, zeu Befondering des Gewerbfleishes in Preussen, published at Berlin, 1846, volume 25, page 228.

Fabrication des Papiers, Dr. L. Muller, second edition, published at Berlin, 1855, page 32 and fig. 1.

Lemuel Wright, English patent, June 15, 1843, No. 7,987.

Lemuel Wright, patent U. S., 1847, Journal des Fabricats de Papier, volume 5, page 34, figures 29 and 30, published at Paris and Arden, November, 1858.

Central Biatte fur deutsche Papier fabrication, No. 29, 15 Nov., 1852, page 483.

3. These defendants further say that the said invention, or a material part thereof, was described in the reissued letters of Ladd & Keen, dated April 7th, 1863, and antedated August 19th, 1853, hereinbefore referred to, and that by reason thereof said letters patent of Morris L. Keen, of June 16th, 1863, are null and void.

4. These defendants, further answering, say, that they have no knowledge, save from said bill, as to the license dated May 18th, 1863, in said bill mentioned, nor as to the alleged assignment by Benjamin Buffum to the complainants, nor as to the assignment of Morris L. Keen, dated July 11th, 1865, to the complainant, and they leave the complainant to prove the same.

5. And these defendants, further answering, say that the said alleged invention or improvement was on public sale and use for more than two years prior to the application for letters patent, and that by reason thereof said letters patent are null and void.

114 These defendants deny that they or either of them have ever sold any pulp, in the state of pulp, or in any other state than that of finished marketable paper.

These defendants deny that they ever used either of the processes or machinery described in either of said letters patent in said bill of complaint mentioned, either alone or in combination with each other, or in a combination of any two or more of them as in said bill is charged.

These defendants, further answering, say that they first associated together in the manufacturing of paper in the spring of 1865, and at great expense have erected works near Manayunk, upon the plan and scale described and set forth in the annexed specification and drawing, marked Exhibit , which is a copy of the application for letters patent made by the inventor, John W. Dixon, one of the defendants.

These defendants, further answering, say that the pressure at which they have worked, and do now work, with said apparatus, has varied from fifty to sixty pounds per square inch, and has not been permitted to exceed sixty pounds pressure, the safety valve being adjusted so as to blow off and freely relieve the boiler at sixty pounds pressure.

That the practice pursued by defendants has been, whenever the boiler blows off at sixty pounds, to reduce the heat until it ceases to blow off. That the strength of solution which the defendants have used, and which they have found by experience to answer best, is from four to six degrees Beaume, with wood.

That these defendants' first mode of operating was as follows:

The wood was treated with a solution of caustic alkali, of the strength of 12 degrees Beaume, at a temperature of about fifty pounds, and never exceeding sixty pounds to the square inch, until the pulping was complete. The waste liquor was then drawn off. In the first operation the pulp was was forced out by the pres-

115 sure of steam in the top of the boiler into an open drainer; but within the first few weeks after so using it; it was found better to merely draw off the pulp, without any pressure on top, and that practice has been pursued ever since.

The waste liquor drawn from the first wood-pulping operation was refreshed with twenty-five per cent. of a fresh solution of caustic soda, of same strength as at first, viz: twelve degrees Baeume, and this was used for a second wood-pulping operation at the same temperature as before. The refuse liquor of this second operation was then diluted to about three degrees Beaume, without any fresh ac-

cession of alkali, and this diluted refuse liquor was then used to pulp straw at a pressure of about fifty pounds to square inch, and not exceeding sixty pounds. The refuse from the operation was thrown away.

At a later date the strength of the first solution of caustic soda used on wood was in practice, reduced to five degrees Beaume, and used at the same temperature as above mentioned, viz: about fifty pounds and not exceeding sixty pounds to square inch, and the refuse liquor redosed with 25 to 50 per cent. of fresh solution, of same strength; used again on wood, at fifty pounds to sixty pounds pressure, and the second refuse liquor was used on straw, without any dilution or refreshment, at fifty to sixty pounds pressure.

These defendants, further answering, say that the process of pulping wood by caustic alkali, of the strength described in the reissued patents of Ladd & Keen aforesaid, renders the process too expensive to be practically useful, were it not for the evaporation and recovery of the soda, as pursued by the complainants. These defendants, further answering, say that the weak solution used by the defendants and the reuse of it, as patented by John W. Dixon, render his process a practical and superior process that practiced by complainants, and obviating the necessity of the recovery of the soda by evaporation.

And the defendants, further answering, say that they have never infringed, or intended to infringe, any right of said complain-
116 ant, and they believe that they have a perfect right to make paper pulp, to be made by them into paper as they have been doing, and are fully able to respond to complainant in any amount of damages which they will ever recover against them.

And they claim the benefit of so much of ther answer as goes in bar of the said bill, the same as if such matter had been pleaded thereto, and they humbly submit and insist that, under the facts and and circumstances above stated, the said complainant has no right to writ of injunction as moved for in said bill, and no further answers to said bill than are herein given; and they pray to be hence dismissed, with their reasonable costs and charges, in this behalf most wrongfully sustained.

JACOB D. HEFT.
S. A. RUDOPLH.
JOHN W. DIXON.

UNITED STATES, *Eastern District of Pennsylvania, ss:*

Before me, the subscriber, this 4th day of January, 1866, personally appeared Jacob D. Heft, Sebastian A. Rudolph and John W. Dixon, the defendants in the foregoing answer, and by whom the same is subscribed, and being by me severally duly sworn, according to law, depose and say, that they have read the foregoing answer and know the contents thereof, and that the same is true of their own knowledge.

JACOB. D. HEFT.
S. A. RUDOLPH.
JOHN W. DIXON.

Sworn to and subscribed before me this 4th day of January, 1866.
CHARLES SERGEANT,
U. S. Commissioner.

117 (Copy.)

To all whom it may concern:

Be it known that I, John W. Dixon, of the city of Philadelphia, and State of Pennsylvania, have invented a new and useful improvement in the apparatus for making wood, straw or manilla pulp; and I do hereby declare the following to be a full and exact description of the same, reference being had to the annexed drawings, making a part of this specification in which figure 1 represents a side view of my entire apparatus.

A and B are two upright boilers of wrought iron, capable of sustaining considerable pressure, say $\frac{3}{8}$ inch thick. I place across the interior of each of these boilers a perforated diaphragm C, figure 1, with an opening through it, covered by a removable perforated cover D. This is placed about 1-10 of the attitude of the boiler below, the top of a lower perforated diaphragm E is placed in each boiler near the bottom slightly conical, or tapering downward towards a central opening F. This opening F is connected by a pipe or tubing G G, with the exterior pipe for carrying off the contents; a slide valve H, operated by a stem I, covers this opening F in each boiler, passing through a stuffing box K. The top of each boiler is surmounted by a cover or head L or L', furnished with safety valves, and having a man-hole and cover. M. O. is a furnace or vertical fire chamber, having a coil or pipe P P, extending through it. Figure 1, with grate bars at R, as is usual in furnces and flues, and having also proper dampers. A tube S S′ S″, extends across in front of the lower part of the two boilers A and B, and is connected with the lower extremity of the coil of tubes P P′. Locks are placed at No. 1 and No. 2, leading respectively to boilers A and B. At T a
118 rotary force pump is placed in the course of the tube S S′ S″, driven by an exterior pulley across the top of the boilers. A tube U U′ U″, connecting by cocks at 4 and 5, with the upper part of boilers A and B, respectively, and connecting with the top of the coil P P′. This apparatus is intended mainly to carry out the improved process for which letters patent have been heretofore grantd to me, and the operation is as follows:

The boiler A is to be charged with chipped or cut wood through the man-hole M, the boiler is then to be filled or partly filled, with a solution of caustic soda, say from 4° to 8° Beaume or thereabouts, the lid D, having been removed from the centre of the perforated diaphragm C, while the wood is being changed and replaced, and buttoned or latched down before the caustic liquor is poured in. After the solution of alkali has been charged in, the man-hole is bolted down. The fire under the coil P in the furnace, having been kindled, the cock 1 is opened, also the cock 4, the other cocks and valves being closed. The pump T is made to revolve by a belt. This pump forces the digesting liquid strained from the wood fibres

from the space below the perforated diaphragm E up through the coil P, and through the pipe U U′ U″, and through the open cock 4, to the upper part of the boiler A. This fluid descends through the mass of wood or vegetable fibrous matter being treated, and passes out through cock 1 and tube S S′ S″ towards the vertical coil P P′ as before, thus a forced circulation through the heating coil P P′ is constantly maintained, and a much more rapid heating and digesting action is obtained than can be obtained in any other way. The contents of the boiler A are to be heated above 212°. I find the apparatus works well with wood and straw at a pressure of 50 to 60 lbs. The requisite pressure being obtained by loading the safety valve, after the contents of boiler A have been subjected for a sufficient time to the circulating action as above described, in order to digest the woody fibres, which time depends on the nature of the digesting liquor, pressure and nature of material treated.

119 While the contents of boiler A, are being thus treated, the boiler B is to be prepared thus: It is to be charged with chipped woody matter, in the same way as above described for boiler A. The man-hole cover M and diaphragm lid C, having been removed for the above purpose.

An increased per centage of solution of caustic soda, say about 20 per cent. of the quantity first charged into boiler A, is to be charged into this boiler B, at a strength of from 4° to 8° Beaume; the man-hole and covers are then closed down. One boiler having been thus prepared is operated as follows: As soon as boiler A is finished digesting, the cock No. 5 is opened and No. 4 is shut, and the liquid contents of boiler A are then drawn off from the bottom of A, and driven by the rotary pump T, through the coil P P′, and pipe U U′ U″ into the top of boiler B. When the boiler A is thus emptied of its liquid contents into B, cock No. 1 is shut and cock No. 2 is opened, B, being thus filled with heated liquid from A. A is isolated by closing of cocks 1 and 4. The circulation through the coil and the boiler B goes on as before described, by the aid of the pumps, and the digested pulpy matter from A is drawn off by pulling out the slide valve H, and can be led off to the tanks or reservoirs.

While the contents of boiler B are being cooked A is to be filled with, say, cut straw, and the liquid contents of B are to be drawn off and forced into A, by closing valve 5 and opening valve 4, and when all the liquid contents of B are forced into A, the cock 2 is to be closed and cock 1 opened, by which B becomes isolated, and the slide valve in the lower part of B is to be opened, and the pulp or solid contents discharged out.

This alternate action of the two boilers could be kept up for any length of time, although in my process patent I have described the manner in which I prefer to use the refuse of one operation for a succeeding one.

I do not desire to claim herein the combination of upper
120 and lower perforated diaphragm, nor the combination of lower diaphragm and valve, as these are the subjects of claim in another application filed by me heretofore, but what I do claim and

desire to secure by letters patent, is, the combination of the two boilers A and B, the coil P P' and the circulating pump, the tubes connecting them together for the purpose of throwing the digesting liquid, while heated and under pressure, from one boiler to another, substantially as above described.

JOHN W. DIXON.

Witnesses—
CHARLES H. WHITE.
J. E. MCCAULLEY.

(Here follows map, marked page 120.)

121

122 In the Circuit Court of the United States for the eastern district of Pennsylvania. April term. 1865. No. 20.

The replication of American Wood Paper Company, complainant, to the answer of Jacob D. Heft, S. A. Rudolph, and John W. Dixon, defendants.

THE AMERICAN WOOD PAPER COMPANY
vs.
JACOB D. HEFT *et al.*
} Sitting in Equity.

This repliant, saving and reserving unto himself all manner of advantage of exception to the manifold insufficiencies of the said answer, for replication thereunto, saith: That they will aver and prove his said bill to be true, certain, and sufficient in the law to be answered unto, and that the said answer of the said defendants is uncertain, untrue, and insufficient to be replied unto by this repliant; without this, that any other matter or thing in the said answer contained, material or effectual in the law to be replied unto, confessed and avoided, traversed or denied, is true; all which matters and things the said repliants are and will be ready to aver and prove, as this honorable court shall direct, and humbly prays as in and by their said bill they have already prayed.

J. A. JENCKES,
J. SHEPHARD,
HENRY E. WALLACE,
Solicitors for Complainant.

123 In the Circuit Court of the United States for the eastern district of Pensylvania, April sessions, 1865.

Complainant's testimony taken before C. Sergeant. esq., at his office, No. 123, South Fift street, Philadelphia.

THE AMERICAN PAPER WOOD COMPANY
vs.
JACOD D. HEFT *et al.*
} No. 21.

OCTOBER, 17*th*, 1866.

Present, H. E. Wallace, esq., for complainants; Geo. Hardings, esq., for defendants.

B. Howard Rand, a witness for complainants, being duly sworn, deposeth and saith, as follows, viz:

Q. 1. What is your name, age, residence, and occupation?

A. B. Howard Rand; I am thirty-nine years old; I reside at Summer street, Philadelphia; I am professor of chemistry in Jefferson Medical College.

Q. 2. State what experience you have had in chemistry as applied to the arts, and what knowledge you have of its special application to the manufacture of paper pulp, and of paper?

124 A. I have been teaching chemistry since 1853, and have made myself acquainted from time to time with its application to the arts. My knowledge of its special application to the manufacture of paper pulp and of paper has been derived from observations and experiments made during the past summer and up to the present time.

Q. 3. Have you examined the reissued patents, numbered 1,448 and 1,449? and if so, will you state whether you understand the invention therein described and patented.

A. I have examined them, and do understand the invention therein described and patented.

Q. 4. State whether or not the language of the specifications describes in full, clear, and exact terms the process of manufacturing paper pulp from wood and other vegetable substances, so as to enable yourself or any person skilled in the art of paper-making to manufacture the same.

A. They do so describe it.

Q. 5. What in your opinion are the characteristics of the invention described in these specifications?

A. Boiling wood, straw, or other vegetable substances with a solution of caustic alkali, at a temperature at, near, or above 800° Fahrenheit; and, when necessary, the use of chlorine, or its compounds, with oxygen, for the purpose of obtaining white pulp for use in paper-making. It is a chemical process, and chemical action, in many cases, requires a certain temperature.

Q. 6. Have you examined the patents granted to M. A. C. Mellier, dated May 26, 1857, antedated to August 7, 1854? and if so, do you undertand the same, and the invention therein described?

A. I have examined them, and understand the invention therein described.

Q. 7. State what knowledge you have of the processes used by the defendants, Jacob D. Heft, S. A. Rudolph and John W. Dixon, in the manufacture of paper pulp, and paper from wood, straw, and other vegetable substances.

A. My knowledge is derived from the defendants' answer, and the report of Messrs. Muckle, Garret and Neal.

Q. 8. State whether or not, in your opinion, the processes used by the defendants are substantially the same as those

125 described and patented by the persons and in the patents above referred to, and give your reasons in full for your opinion.

A. I think the processes are substantially the same. The temperature used by the defendants is at, near, or above 300° F., and the processes are chemically similar, the manipulations and the mode of procedure are similar; the product, as examined by me, is inferior in quality, because, I believe, they have not employed the temperature best adapted to the material employed. The specimen examined was pulp from wood. I have not examined any straw specimen of defendants' manufacture.

Q. 9. Have you examined the patents granted to Morris L. Keen, dated September 13, 1859, and May 18, 1863, for improvements in boilers for making paper pulp from wood? State whether you understand the same; and if so, state the characteristics of the invention therein described and claimed.

A. I have examined those patents. The characteristics are the patent stirrers; the expansion chamber with a strainer, the object of which is to keep the wood immersed in the liquor, and yet allow of the expansion of the liquor under the influence of an increase of temperature; and a discharge valve or cock at or near the bottom of the boiler, by means of which the pulp may be gradually blown out under steam pressure, for the purpose of opening out masses of fibre of wood and straw or other vegetable substances previously disintegrated by chemical action.

Q. 10. State what knowledge you have of the boilers used by the defendants in this suit?

A. The drawings attached to the report of Messrs. Muckle, Neal, and Garrett.

Q. 11. State whether or not, in your opinion, the boilers used by the defendants are substantially the same in construction and modes of use and operation as those described and patented in the patents above referred to, and give your reasons for your opinion.

A. I believe the boilers to be substantially the same in construction and mode of use and operation. In both there is an expansion chamber, or its equivalent. In both the pulp is forced out by steam pressure by opening a valve near the bottom of the boiler. The
126 expanding steam separates the masses of fibre previously disintegrated by chemical action, and the removal of the liquor, by percolation or displacement, is thus facilitated.

Q. 12. State what, in your opinion, is the fibre necessary and requisite for the manufacture of paper pulp and paper from wood, straw, and other vegetable substances; and also state what the component and constituent parts of that fibre are known to be; and also what component or constituent parts of the wood, straw, and other vegetable substances should be removed or destroyed.

A. Those fibres which are flexible, thoroughly detached from each other, pliable, and capable of felting or matting. Cellulose possesses these properties. It consists of carbon, hydrogen, and oxygen. Wood, straw, and other vegetable matters contain, besides cellulose, intercellulose, which has a different physical and chemical constitution. It is injurious, and should be removed. The purer the cellulose produced from wood, straw, &c., the more easily is such cellulose

converted into paper, and the better is the quality of the resulting paper.

Q. 13. State whether or not the requisite fibre can be obtained and the foreign or injurious substances removed by chemical agency, and whether or not they can be removed or obtained by any other agency, and give reasons for your opinion.

A. The requisite fibre can be obtained and the injurious substances removed by chemical but not mechanical means. I have made experiments on this subject, and find that if you reduce the ratio of caustic alkali to that of wood of average dryness, much below 16 per cent., or that if we do not employ the solution of caustic alkali taken at 12° B., at a temperature above 316° F., which corresponds to a steam pressure of 60 pounds to a square inch, the intercellulose is not completely removed. I have made experiments, and am engaged in preparing a table of the same, which I will submit as an exhibit.

Furthermore, increasing the quantity of alkali does not compensate for the dimunition of temperature. Greatly prolonged action at diminished temperature does remove a certain amount of intercellulose, but does not in any case produce a pure cellulose. I find that
127 a temperature corresponding to about 160 pounds of steam pressure, and alkali in proportion before stated, to wit, 16 per cent. of wood of average dryness, will produce a pure cellulose, but that if the quantity of alkali be reduced below 12 per cent. of the weight of wood of average dryness, pure cellulose is not obtained, and that a still further reduction in the quantity of the alkali causes the product to rapidly deteriorate. I find that the proportion of cellulose in the wood experimented upon is, to a great extent, fixed and definite. That in wood of average dryness yielded, in my experiments, from 30 to 37 per cent.

Q. 14. State and describe, if you know, what is "pure cellulose," and how obtained, and where?

A. Pure cellulose is the true fibre or tubular structure of wood. It is wholly and freely soluble in sulphuric acid, without browning or blackening. It solution in sulphuric acid is clear and colorless. It is best obtained by boiling vegetable substances in strong caustic alkali, at a high temperature, say one corresponding to a steam pressure of 160 to 170 pounds to a square inch. Cellulose exists nearly pure in cotton and bleached linen fibre.

Q. 15. State whether or not pure cellulose can be obtained from wood, straw, or other vegetable substances by other than chemical agencies, and give your reasons for your opinion.

A. Pure cellulose cannot be obtained from wood, straw, or other vegetable substances by any other process that I know of than chemical agencies. The reason is that the cellulose and intercellulose are so intimately united that no known mechanical means can separate them. Ground wood is added to pulp as a filling, like clay or kaolin, but its intercellulose is not destroyed.

Q. 16. Have you examined and are you familiar with the patent granted to Clothan Breuil, dated February 12, 1846, (French patent,

defendants' Exhibit No. 18;) and, if so, state whether such patent is for the same, or substantially the same process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the same, as that described in reissued patent No. 1,448 for a new manufacture; and if not, state why not, and state fully wherein the
128 reissued patent differs from the above-mentioned patent of Clothan Breuil, and in what respects they are for distinct and separate invention?

A. I have examined the patent of Clothan Breuil, February 12, 1846, and do not consider it the same, or substantially the same process, as that described and claimed in reissued patent No. 1,449, neither do I consider the article produced the same or substantially the same as that described in reissued patent 1,448. The reasons for my answer are as follows: The patent of Clothan Breuil refers chiefly to the bark of vegetables; he used a very weak solution of soda, which is not rendered caustic; he used a pressure of two to three atmospheres. It is evident that he does not use sufficient alkali and temperature to even separate the fibres, as they are, after the alkaline treatment, submitted to breaking, dressing, or combing; this last process is impossible, if anything resembling a pulp had been obtained. The small quantity of uncausticized alkali would have only softened the bark; this was all that was desired, and he calls attention to the fact that only weak alkaline solutions should be used. In making paper he exposes the bark to a boiling only in weak caustic alkali, 2 kilogrammes to every 100 kilogrammes of material. As a proof that the alkaline treatment has not removed the interstitial matter he goes on to describe that these materials must be removed by a light breaking down, which loosens these matters, which are then carried away by washing. The only reference made to wood is to branches of osier and willow. He states that the alkaline treatment is the same, but employs stronger mechanical action. There is nothing to show that anything like pulping by alkaline solutions is attempted; it was only a softening of the cuticles preparatory to their removal, not a chemical disintegration of the vegetable matter.

Q. 17. Have you examined and are you familiar with the patent granted to Sieur Gros, March 20, 1847, (French patent, defendants' exhibit No. 19;) and, if so, state whether such patent is for the same, or substantially the same process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the
129 same as that described in reissued patent No. 1,448, for a new manufacture; and, if not, state why not, and state fully wherein the reissued patent differs from the above-mentioned patent of Sieur Gros, and in what respects they are for distinct and separate inventions.

A. I have examined it, and it differs from reissued patents of 1,448 and 1,449. The reasons for this belief are as follows: This patent is for the manufacture of pulp from broom only. He treats the bark and wood separately. He boils the bark without pressure

in alkaline solutions, either of lime alone or lime mixed with soda. He then beats in the engine and bleaches. He boils the wood under pressure of about three or four atmospheres in an alkaline solution. of which the strength is so obscurely set forth in the patent, that I am unable to state what it is. He states that for a pulp intended for the various qualities of white paper, the pulp (pate) should be boiled for about six to eight hours (for that gathered) during the spring and summer, with about ten per cent. of its volume of a saturated solution of sal soda (crystallized carbonate of soda) rendered caustic with about five per cent. of good lime, and about eight to twelve hours for the broom, collected during autumn and winter, in a lye bath containing about fifteen to twenty per cent. of the same solution. After this boiling the wood is, without washing, to be heaped up for fifteen days, and then placed in the engine and crushed with the roll till it looks like a mass of unravelled fabric. It is then again boiled in the same way as at first, and then completely beaten out. It is again washed; submitted to the action of chlorine gas; again washed and bleached. In this patent the treatment with alkali is only a softening process; the real disintegration of the fibre is effected by mechanical means. A more complete disintegration is effected by the second beating in the rag-engine. If this were not so, the expression "effilache completement et plus fin que pour le chiffons" would not have been used. since, if it were completely pulped by chemical agency, as in the Watt and Burgess patent 1,448 and 1,449, reissued, the pulping would be of a complete and definite character. When a vegetable substance is completely pulped, that is, when the whole of the intercellulose is removed, very slight mechanical action is sufficient to separate the already isolated fibres.

130 Q. 18. Have you examined and are you familiar with the patent granted to Sieur Mege, dated June 27, 1845, (French patent, defendant's Exhibit No. 15?) and if so, state whether such patent is for the same, or substantially the same, process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the same, as that described in reissued, patent No. 1,448 for a new manufacture; and if not, state why not; and state fully wherein the reissued patent differs from the above-mentioned patent of Sieur Mege, and in what respects they are for distinct and separate inventions.

A. I have examined the patent named, and believe it to differ from the Watt and Burgess patent 1,448 and 1,449, reissued. The reasons for my opinions are as follows: He boils in alkali, containing fifteen per cent. caustic potash or soda, 1.16 s. g., 21° B., for six hours, but does not mention pressure. He treats with chlorine or nitric acid, washes in dilute alkali, and bleaches. This patent resembles the Watt and Burgess patent, with the exception that he does not use pressure, and does not employ a similar per cent. of alkali.

Q. 19. Have you examined and are you familiar with the pat

granted to Sieur Roque, dated Nov. 7, 1845, (French patent, defendant's Exhibit No. 17?) and if so, state whether such patent is for the same, or substantially the same, process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the same, as that described in reissued patent No. 1,448 for a new manufacture; and if not, state why not; and state fully wherein the reissued patent differs from the above-mentioned patent of Sieur Roque, and in what respects they are for distinct and separate inventions.

A. I have examined the patent named, and believe it to differ from the Watt and Burgess patent, reissues 1,448 and 1,449. My reasons are as follows: The patent refers to plants only. He evidently alludes to those without much woody tissue, as he instructs that the plants be pressed so as to remove the water, glutenous, and fleshy parts. This could not be the case with wood. He boils,
131 without pressure, in a caustic solution of soda. Part of the receipt for making this solution is unintelligible, as he uses either lime or chloride of lime mixed with carbonate of soda. The chloride of lime, if by this is meant bleaching salt, would, by a double decomposition with carbonate of soda, form carbonate of lime and a solution of hypochlorite of soda and chloride of sodium. The above solutions are rendered quite weak with water before using. The result of boiling in each of these solutions seems to be to remove the gluten or some parenchyma; but true pulping has not been effected, as the patentee states that the material may be used for ropes, &c., and describes it as being similar to hemp or flax.

Q. 20. Have you examined and are you familiar with the patent granted to Laforrest, Berryer, Son & Co., dated November 24, 1825, (French patent, defendant's Exhibit No. 5?) and if so, state whether such patent is for the same, or substantially the same, process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the same, as that described in reissued patent No. 1,448 for a new manufacture; and if not, state why not; and state fully wherein the reissued patent differs from the above-mentioned patent of Laforrest, Berryer, Son & Co., and in what respects they are for distinct and separate inventions.

A. I have examined the patent named, and believe that it differs from the reissued patents of 1,448 and 1,449. The following are my reasons: The patentees employ the woody part of certain plants, as hops, hemp, maize, &c., but not wood in its true sense. They macerate in water; crush, ferment in bran water; wash, expose to an alkaline bath of lime-water; and then place it in a solution of caustic soda of the strength of 1½° to 2° Baume. They do not mention what proportion of the alkaline solution they used, or state whether they boil under pressure; but as they subsequently say that the material is tinged yellow by the process, it is a proof that no decided pulping action had taken place, as the material would then have assumed a dark or a gray color. The yellow color alluded to

by them is only produced by a very slight alkaline treatment, which would be the case in a very weak solution, as indicated by
132 them. The material is subsequently beaten and bleached with chloride of lime, and finally treated with a sulphuric acid bath.

Q. 21. Have you examined and are you familiar with the patent granted to Charles Wise, dated May 12, 1838, (French patent, defendant's Exhibit No. 10?) and if so, state whether such patent is for the same, or substantially the same, process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the same, as that described in reissued patent No. 1,448 for a new manufacture; and if not, state why not; and state fully wherein the reissued patent differs from the above-mentioned patent of Charles Wise, and in what respects they are for distinct and separate inventions.

A. I have examined the patent alluded to. It differs from the reissued patents 1,448 and 1,449. It is a patent for a boiler for the purpose of boiling rags and other material for the purpose of paper making, in alkaline solutions. The patent includes two classes of boilers, the one stationary, the other rotary. The stationary boiler is heated by fire under the boiler; the rotary boiler by steam. In neither case is pressure alluded to, although it is to be presumed that pressure would be obtained. This patent is for an apparatus, not for chemical decomposition of wood and straw, or other vegetable material, which depends on a certain quantity of chemical material at a certain temperature.

Q. 22. Have you examined and are you familiar with the patent granted to Bronzac, Chaptal & Darcet, December 30, 1824, (French patent, defendant's Exhibit No. 2?) and if so, state whether such patent is for the same, or substantially the same, process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the same, as that described in reissued patent No. 1,448 for a new manufacture; and if not, state why not; and state fully wherein the reissued patent differs from the above-mentioned patent of Bronzac, Chaptal & Darcet, and in what respects they are for distinct and separate inventions.

A. I have examined the patent named. I believe it to differ from the reissued patents 1,448 and 1,449. They employ the
133 straw of cereals, which is placed in large reservoirs, which may be made of wood, or of any other substance not affected by alkali. They pour over the straw a boiling solution of caustic soda, and allow the straw to macerate in the solution until completely soft. They do not refer to boiling the straw. They ferment and bleach with a large proportion of chloride of lime, 67 kilos. of chloride of lime to 100 kilos. of straw. The disintegration is really effected by this large proportion of chloride of lime. For absolute bleaching purposes four parts of chloride of lime to 100 parts of raw material is all that is necessary, if entire pulping had been pre-

viously effected. The patentees state that they obtain 75 parts of pulp from 100 parts of straw. As straw will only yield from 35 to 40 per cent. of pulp, it is evident that they had not obtained pure pulp.

Q. 23. Have you examined and are you familiar with the patent granted to Sieur Chabert a Rouen, May 11, 1839 (French patent, defendants' Exhibit, No. 14)? and if so, state whether such patent is for the same or substantially the same process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgesss patent,) and whether the article produced is the same or substantially the same as that described in reissued patent No. 1,448, for a new manufacture; and if not, state why not; and state fully wherein the reissued patent differs from the above mentioned patent of Sieur Chabert a Rouen, and in what respects they are for distinct and separate inventions.

A. I have examined the patent named. It differs from the reissued patents 1,448 and 1,449. The patentee alludes to Colza family only. He macerates in a solution of soda potash; he does not boil in this solution; the only allusion to boiling is boiling with lime; and he states that this lime-bath answers better than one of soda or potash.

134 OCTOBER 18, 1866.

Present, counsel for respective parties.

Q. 24. Have you examined and are you familiar with the patent granted to Montgolfier Freres, dated February 7, 1838, (French patent, Defendants' Exhibit, No. 11?) and if so, state whether such patent is for the same or substantially the same process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the article produced is the same or substantially the same as that described in reissued patent No. 1448, for a new manufacture; and if not, state why not; and state fully wherein the reissued patent differs from the above-mentioned patent of Montgolfier Freres, and in what respects they are for distinct and and separate inventions.

A. I have examined said patent. It differs from the reissued patents Nos. 1,448 and 1,449. In the Montgolfier patent, wood is rasped down, stepped in lime-water to soften the wood, ground, boiled in caustic alkaline solutions under pressure, crushed between rolls, reboiled in alkali, bleached by chlorine and soda, in vacuo. In their second reissue, they state that after the alkaline boiling, the wood may be converted into a white pulp by means of their process for bleaching. They state, however, that the usual bleaching process will not succeed on the pulp produced as above, and they refer this failure to the fact that all the resin has not been removed from the wood. This is rendered plain from the fact that in the pulp, which was not disintegrated by the bleaching process, they recement the fibres by the removed resin, which would show that the fibre could not be converted into paper without the cementing action. That they obtain merely disintegrated wood, and not pure pulp, is clearly proved by

the fact that they put down the total loss in the conversion of wood to pulp at 30 per cent., or, in otherwords, they obtain 70 per cent. of fibre. Now, wood of average dryness will only give from 30 to 35 per cent. of pure fibre. They give the cost at 10 francs the 100 kilos., while they state that the costs of rags was 63 francs the 100 kilos. If the pulp obtained would really make paper at this great profit, the process would have come into practical use, which I have every reason to believe was not the case. By practical use, I mean
135 employment on the large scale to produce a commercial article.

Q. 25. Have you examined and are you familiar with the patent granted to Monier Legoux, dated March 12, 1839 (French patent, defendants' Exhibit, No. 12?) and if so, state whether such patent is for the same or substantially the same process as that described and claimed in reissued patent No 1,449, (the Watt and Burgess patent,) and whether the article produced is the same or substantially the same as that described in reissued patent No. 1,448; for a new manufacture; and if not, state why not; and state fully wherein the reissued patent differs from the above-mentioned patent of Monier Legoux, and in what respects they are for distinct and separate inventions.

A. I have examined the patent alluded to and it differs from the reissued patents Nos. 1,448 and 1,449. The patentee reduces the vegetable substances among which he mentions wood, to a material resembling rag half-stuff ("une espece de fillasse ressemblant un defile produit par les chiffons.") He then boils this product under pressure of three or four atmospheres in a solution containing a small quantity of boracic acid, containing common soap as caustic as possible. After washing he states that the product is fit for paper making. The only effect of the boracic acid would be to neutralize some of the alkali of the soap. This boiling process manifestly was only a softening of the mechanically disintegrated wood. No real chemical distinegration could be obtained by such weak chemical agents. He states that the process may be rendered more effective by a previous maceration in a caustic lye composed of two parts, one of barilla, soda or potash. the other of boracic acid and unslaked lime. The acid would combine with the alkali and form a borate.

Q. 26. Have you examined and are you familiar with the patent granted to Seguin, 1801, (Defendants' Exhibit, No. 1?) and if so, state whether such patent is for the same or substantialy the same process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent.) and whether the article produced is the same or substantially the same, as that described in reissued patent No. 1,448, for a new manufacture; and if not, state why not; and state fully wherein the reissued patent differs from the
136 above-mentioned patent of Seguin, 1801, and inwhat respects they are for distinct and separate inventions

A. I have examined the patent named, and it differs from reissued parents Nos. 1,448 and 1,449. It refers to straw and the stalk of plants only. The patentee cuts them and soaks them in lime-water or a solution of caustic soda or potash until they form a soft mass. He does not mention boiling at all.

Q. 27. Have you read, examined, and considered the extract from Berlege, Zu, No. 35, Central Blattes fur Deustache Papier fabrication, No. 35, May 15, 1852, at page 15, and note on said page (defendant's Exhibit, No. 24?) and if so, state whether the process there described is the same, or substantially the same, as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the articles produced is the same, or substantially the same, as that described in reissued patent No. 1,448, for a new manufacture; and if not, state why not; and state fully wherein the reissued patent differs from the process in the above-mentioned extract from Berlage, and in what respects they are for distinct and separate inventions.

A. The only notice therein that has any bearing on the questions at issue is contained in the foot-note which alludes to Gustave Schauffelens having introduced the closed boiler and high-pressure steam. There is nothing to infer that he boiled anything but rags.

Q. 28. Have you read, examined, and considered the extract from Central Blatte, &c., No. 27, Van Halle, a S. 815, September, 1852, p. 449 to 451 (defendants' Exhibit, No. 25?) and if so, state whether such an article describes a process substantially the same as that described in reissued patent No. 1,448, (the Watt and Burgess patent,) and whether the product of such process is the same as that described in reissued patent No. 1,448, for a new manufacture; and if not, state why not; and state fully the difference between them.

A. In the notice on making paper from straw in Central Blatte, No. 27, Sept. 15, 1852, the author states that in England straw is boiled once or more in strong lye, under six to eight atmospheres, and then quotes Lemuel W. Wright as a successful maker. He does not allude to any patent or before published process under which
137 this operation is carried on. There must be some error in his statement, as straw is prepared easily with weak alkali at a pressure of six atmospheres; yet he states that the straw is to be boiled once or often in a strong lye, at a pressure from six to eight atmosphere. Wright's process is more or less compound one, in which he does not trust to the boiling in alkaline solutions alone. Wright uses weak solutions, and does not state the pressure he uses, which, from the nature of his apparatus, was probably considerably below the lowest of these pressures. It is not usual to allow visitors to chemical works to know the actual strengths of solutions or pressures used. The hydrometers, thermometer and gauges are made to indicate falsely, or are "blind." The proprietors or foremen only know their true meanings.

Q. 29. Have you read, examined, and considered the article from Central Blatte, No. 30, Dec. 15, 1852, (defendant's Exhibit No. 28?) And if so, state whether such articles describes a process substantially the same as that described in the reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the product of such process is the same as that described in reissued patent, No. 1,448, for a new manufacture; and if not, state why not, and state fully the difference between them.

A. I have examined the extract from Central Blatte, No. 30, Dec. 15, 1852. It is only a notice of the wood-paste or filling produced by Volker by grinding wood. The reference made to Donkin's apparatus "admitting of a high pressure of steam," seems only a suggestion that some good effects may result from its use. No allusion is made to the use of alkaline solutions. The substance produced by grinding wood cannot be called pulp.

Q. 30. Have you read, examined, and considered the article from Industrie Austellung zu London, 1851, (defendant's Exhibit No. 26?) And if so, state whether such article describes a process substantially the same as that described in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the product of such process is the same as that described in reissued patent No. 1,448 for a new manufacture; and if not, state why not, and state fully the difference between them.

138 A. I have examined the extract from Industrie Austellung, zu London, 1851. On the last page is an allusion to straw paper. After stating that a firm, beautiful paper is made from cotton and linen waste, the writer refers to straw paper by saying that the "new appearance of this paper at the exhibition, 1851, may be taken as a sign that the making of the finer sorts out of this material (straw,) although it may be practical and feasible, yet it accomplishes no economical results, and therefore will not be carried further." In foot-note 8 the same statement as to boiling straw in strong lye under pressure, as alluded to in answer No. 28, made. The remarks in that answer apply in this case.

Q. 31. Have you examined and are you familiar with the patent granted to A. S. Lyman, August 3, 1858, (defendant's Exhibit No. 36?) And if so, state whether such patent is for the same, or substantially the same, process as that described and claimed in re-issued patent No. 1,449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the same, as that described in re-issued patent No. 1,448 for a new manufacture; and if not, state why not, and state fully wherein the reissued patent differs from the above-mentioned patent of A. S. Lyman, and in what respects they are for distinct and separate inventions.

A. I have examined the patent of A. S. Lyman, August 3, 1853, as above. It differs from the reissued patents No. 1,448 and 1,449. He disentegrates the wood, straw, flax, &c., by charging the interstices of the vegetable substances with the elastic vapor of water or other liquids, and then suddenly projecting the materials so charged into the air, when the material is more or less torn apart by the elastic vapor enclosed in its interstices. This is not properly a chemical process, but simply a mechanical one. The intercellulose not being removed, true pulp is not obtained. In some plants, as bamboo, a change of the intercellular matter is effected, probably by the high temparature, so that a portion of the intercellulose is rendered soluble in alkaline solutions.

Q. 32. Have you examined and are you familiar with the patent granted to William Magaw, dated March 8, 1828, and May 22, 1828,

(United States patent?) And if so, state whether such patent is for the same, or substantially the same process as that described
139 and claimed in reissued patent No. 1, 449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the same, as that described in reissued patent No. 1,448 for a new manufacture; and if not, state why not, and state fully wherein the reissued patent differs from the above-mentioned patent of William Magaw, and in what respects they are for distinct and separate inventions.

A. I have examined the patent of William Magaw, March 8, 1828. It differs from the reissued patents Nos. 1,448 and 1,449. It refers to hay, straw, and other vegetable substances. He boils them in an open vessel in a solution of ashes, which would consist principally of carbonate of potassa. He states that a steeping for several days answers as well as boiling; consequently no decided chemical action could take place.

Q. 33. Have you examined and are you familiar with the patent granted to Coupier and Mellier, May 17, 1851, (French patent, defendant's Exhibit No. 46?) And if so, state whether such patent is for the same, or substantially the same process, as that described and claimed in reissued patent No. 1, 449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the same as that described in reissued patent No. 1,448 for a new manufacture; and if not, state why not, and state fully wherein the reissued patent differs from the above-mentioned patent of Coupier and Mellier, and in what respects they are for distinct and separate inventions.

A. I have examined said patent, and it differs from the reissued patents Nos. 1,448 and 1,449 They boil straw, bark, or wood in a solution of caustic soda or potash, eight or ten degrees Beaume, equal to 11.2 to 14 Twaddell, at a temparature of 100° to 110° C., equal to 212° to 230° F. They then treat with hypochlorites, chiefly hypochlorite of alumina. They treat wood, without previous boiling, with nitric acid. The patent differs from the Watt and Burgess patent in the very slight use of pressure boiling. For wood they seem to confine themselves solely to the nitric acid process. No mention whatever is made as to the mode of treating wood in the alkaline boiling portion of the patent. All the instructions relate to straw only. I do not believe that they produced a pulp from wood by the process of boiling in alkali.

140 Q. 34. Have you examined and are you familiar with the patent granted to Lemuel W. Wright, dated March 27, 1847, (United States patent, defendant's Exhibit No. 21?) And if so, state whether such patent is for the same, or substantially the same process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the same as that described in re-issued patent No. 1,448 for a new manufacture; and if not, state why not, and state fully wherein the reissued patent differs from the above-mentioned patent of Lemuel W. Wright, and in what respects they are for distinct and separate inventions.

Q. 34. I have examined said patent; it differs from the reissued patents Nos. 1,448 and 1,449. The patentee employs straw and other fibrous substances; boils in lime, grinds, washes; boils in lime and alkali; washes, digests in dilute solution of sulphuric or other acid; washes, reboils in an alkaline solution; washes, bleaches at a temperature of 212°; sours and washes. In boiling in the alkaline solution he does not state definitely the strength of the solution, but says the straw is to be again boiled for six hours in the lime water, as before described, mixed with an alkaline solution of the specific gravity of two to four Baume. In the previous boiling in lime-water, the kier was filled half full of straw, and the remaining space filled with lime-water. If we suppose that by the word mixed he employs equal quantities of lime-water and the solution of soda ash, his strength would be from one to two degrees Beaume, or, when rendered caustic by the action of lime, 0.86° to 1.72°. It is only by repeated processes that he removes his intercellular tissue, if it be removed at all. In boiling both in lime-water and alkali he uses close kiers of cast or wrought iron, which are fitted with safety-valves, but further than this he does not allude to pressure; and from the construction of his boilers or kiers it is evident that no considerable pressure could be carried. The boilers figured in the drawing added to the specification would not be either tight or safe at a pressure of two atmospheres.

Q. 35. Have you examined and are you familiar with the patent granted to Lemuel W. Wright, dated 1833, June 15th, No.
141 7,987, (English patent, defendant's Exhibit No. 20?) And if so, state whether such patent is for the same, or substantially the same, process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the same as that described in reissued patent No. 1,448 for a new manufacture; and if not, state why not, and state fully wherein the reissued patent differs from the above-mentioned patent of Lemuel W. Wright, and in what respects they are for distinct and separate inventions.

A. I have examined the English patent of Lemuel W. Wright, of June 15, 1843. What I have said in regard to the United States patent will apply to this.

Q. 36. Have you examined, and are you familiar with the patent granted to George Spofford, dated September 27, 1840, and the reissued patent therefor, granted to John Campbell, dated June 7, 1850? (defendant's Exhibit, No. 13,) and if so, state whether such patent is for the same, or substantially the same, process as that described and claimed in reissued patent No. 1,449, (the Watts and Burgess patent,) and whether the article produced is the same, or substantially the same, as that described in reissued patent No. 1,448, for a new manufacture; and if not, state why not; and state fully wherein the reissued patent differs from the above-mentioned patent of George Spofford and John Campbell, and in what respects they are for distinct and separate inventions.

A. I have examined, &c., the patent granted to George Spofford

September 27, 1840, and the reissued patent to John Campbell, June 7, 1850. They are for an apparatus for boiling under pressure. This patent is almost a copy of that of Wise, 1838. It refers to boiling rags, straw, and cotton, but not to wood.

Q. 37. Have you read, examined, and considered the extract from Central Blatte, &c., No. 29, 15th November, 1851, page 483? (defendant's Exhibit, No. 23;) and if so, state whether such article describes a process substantially the same as that described in reissued patent No. 1,440, (the Watt and Burgess patent,) and whether the product of such process is the same as that described in re-
142 issued patent No. 1,448, for a new manufacture; and if not, state why not? and state fully the difference between them.

A. I have done so. It is simply an allusion to the fact that one of Donkin's rag boilers was put up at Voelters, and a slight description of the mode of working the same. No reference is made to boiling anything but rags. The pressure used is one and a half atmospheres.

Q. 38. Have you read, examined, and considered the article from Central Blatte, No. 35, May 15, 1852? (defendant's Exhibit, No. 27;) and if so, state whether such article describes a process substantially the same as that described in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the product of such process is the same as that described in reissued patent No. 1,448, for a new manufacture; and if not, state why not? and state fully the difference between them.

A. This article does not do so. It is merely a statement in an account of the life of Gustave Schauffelen, that he first introduced pressure boiling, I presume into Germany, which he had seen in Belgium and Holland. It does not mention the materials acted on, or the chemicals used.

Q. 39. Have you examined, and are you familiar with the patent granted to John Jeyes, dated March 30th, 1855? (English patent, defendant's Exhibit, No. 32;) and if so, state whether such patent is for the same, or substantially the same, process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the same as that described in reissued patent No. 1,448, for a new manufacture; and if not, state why not; and state fully wherein the reissued patent differs from the above-mentioned patent of John Jeyes, and in what respects they are for distinct and separate inventions.

A. I have examined and am familiar with said patent. It differs from the reissued patents Nos. 1,448 and 1,449. It refers to the mustard plant, and similar vegetable substances. He boils in strong alkaline solution—does not say caustic alkali—the strength of which is various, according to the quality of the plant, and the boiler in which the stems are subjected to high-pressure steam (he does
143 not state the amount of pressure) until the fibres are separated. The fibres are then submitted to a pulping machine, and reduced to a pulp. As his pressure and strength of alkali are indefinite, and he refers to the pulping by the machine, it seems probable that boiling in alkali merely softens the stalks.

OCTOBER 22, 1866.

Present: Counsel for respective parties.

Q. 40. Have you examined, read, and considered the article from the Franklin Journal, vol. I., 1826? (defendant's Exhibit, No 3?) and if so, whether such article describes a process substantially the same as that described in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the product of such process is the same as that described in reissued patent No. 1,448, for a new manufacture; and if not, state why not; and state fully the difference between them.

A. I have examined, read, and considered the article from Franklin Journal, vol. I., 1826. This article does not describe a process or product as described in reissued patents Nos. 1,448 and 1,449. There is a notice of a patent granted to Louis Lambert, Paris; he boils with quick-lime or caustic soda, potash or ammonia, washes and submits to a so-called hydro-sulphuret, composed of quick-lime and sulphur in solution; he then washes, beats in a paper-mill, bleaches and washes, and reduces in a rag-engine; he does not use caustic alkali under pressure as a means of disintegrating the material.

Q. 41. Have you read, examined, and considered the article from Berthellot on Dyeing? (defendant's Exhibit, No. 43?) and if so. state whether such article describes a process substantially the same as that described in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the product of such process is the same as that described in reissued patent No. 1,458, for a new manufacture; and if not, state why not, and state fully the difference between them.

A. I have examined, read, and considered the article from Berthellot on Dyeing. This article does not describe a process or article similar to those described in reissued patents Nos. 1,448 and
144 1,449. It simply refers to the oxidizing effect in ordinary bleaching. It does not refer to paper making. The article states the fact that the oxidized intercellulose will combine with alkalies to neutralize them, and that on the addition of an acid a blackish precipitate is formed.

Q. 42. Have you read, examined, and considered the article from Vanhandlung des Verein's sur Befondering des Gewerbfleisches in 29;) and if so, state whether such article describes a process sub- Preussen, Berlin, 1846, vol. 25, page 228? (defendant's Exhibit, No. stantially the same as that described in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the product of such process is the same as that described in reissued patent No. 1,448, for a new manufacture; and if not, state why not; and state fully the differences between them.

A. I have examined, read, and considered the article from Verhandlung des Verein's sur Befondering des Gewerbfleisches in Preussen, Berlin, 1846, vol. 25, p. 228. The article refers exclusively to rags; it says nothing about strength or per cent. of solution, and speaks of boiling from $1\frac{1}{4}$ to $1\frac{1}{2}$ atmospheres only.

Q. 43. Have you examined, and are you familiar with the patent granted M. A. C. Mellier, dated May 2, 1855, English patent? (de-

fendant's Exhibit, No. 44;) and if so, state whether such patent is for the same, or substantially the same, process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the same as that described in reissued patent No. 1,448, for a new manufacture; and if not, state why not; and state fully wherein the reissued patent differs from the above-mentioned patent of M. A. C. Mellier, and in what respects they are for distinct and separate inventions.

A. This patent and the reissued patents 1,448 and 1,449 are closely allied. Mellier limits his highest temperature, however, to one corresponding to a pressure of 84 pounds total internal pressure per square inch. He uses but sixteen per cent. of alkali at two to three degrees Beaume. Mellier's process would only pulp
145 wood, if at all, incompletely, and after boiling. In his last claim he says: I claim the within-described process for bleaching straw. Nothing in his patent would lead us to suppose that he proposed to employ wood as a source of pulp.

Q. 44. Have you examined and are you familiar with the patent granted to Jean Theo. Coupier and M. A. Chas. Mellier, August 2, 1853, and the reissue of the same patent to Coe S. Buchanan. (defendants' Exhibit, No. 33?) And if so, state whether such patent is for the same, or substantially the same, process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the same, as that described in reissued patent No. 1,448, for a new manufacture; and if not, state why not; and state fully wherein the reissued patent differs from the above-mentioned patent of Coupier and Mellier, and the reissue to Coe S. Buchanan, and in what respects they are for separate and distinct inventions.

A. I have examined and am familiar with the above patent and its reissue. They differ from the reissued patents 1,448 and 1,449 in that they do not produce pulp by boiling in strong caustic alkali at a high temperature, but rely more on the disintegrating action of the hypochlorites; they make no allusion to wood, and I do not believe that wood could be practically pulped by this process.

Q. 45. Suppose that the defendants used the following mode of operation with wood: "The wood was treated with a solution of caustic alkali of the strength of 12° Baumé, at a pressure of about fifty pounds to the square inch, until the pulping was complete." In your opinion, is the process thus described substantially the same as that described and claimed in the complainants' patents, and give your reasons for your opinion?

A. The process described was substantially the same as that described in complainants' patents. The lowest pressure named, to wit, 40 pounds per square inch, with a solution of caustic alkali 12° B., acting upon the proper proportion of wood to produce pulp, corresponds to a temperature of 308° Fahrenheit, and the reis-
146 sued patent of Watt and Burgess claims the use of a temperature at, near, or above 300° Fahrenheit. Moreover, with

caustic alkali at a strength of 5° B., with the proper proportion of wood for pulping, I find the temperature at fifty pounds to the square inch to be 302.75° Fahrenheit, and with an alkaline solution of 2° Beaumé, under similar conditions, at 50 pounds to the square inch pressure, corresponds to a temperature of 301.5° Fahrenheit. By the proper proportion of wood to alkali, I mean that proportion necessary to remove the whole of the intercellulose, supposing that to be possible at that temperature.

Q. 46. Have you read, examined, and considered, and are you familiar with the following patents and articles, referred to on pages 7, 8, and 9 of defendants' answer, namely: French patent of Clothan Breuil, February 12, 1846, marked No. 18 of defendants' exhibits; French patent, Sieur Gros, March 30, 1847, marked No. 19 of defendants' exhibits; French patent of Sieur Mege, dated June 27, 1845, marked No. 15 of defendants' exhibits; French patent, Sieur Roque, dated November 7, 1845, marked No. 17 of defendants' exhibits; French patent, Laforrest, Berryer, dated November 24, 1825, marked No. 5 of defendants' exhibits; French patent, Chas. Wise, dated May 12, 1838, marked No. 10 of defendants' exhibits; French patent, Sieur Bronzac, Chaptal et d'Arcet, Dec. 30, 1824, marked No. 2 of defendants' exhibits; French patent, Sieur Chabert á Rouen, May 11, 1839, marked No. 14 of defendants' exhibits; patent of Montgolfier Frères, dated February 7, 1838, October 5, 1838, October 16, 1838, marked No. 11 of defendants' exhibits; patent of Seguin, dated 1801, marked No. 1 of defendants' exhibits; patent of Monier Legoux, March 12, 1839, marked No. 12 of defendants' exhibits; article from Berlage, Central Blattes, No. 35, May 15, 1852, marked No. 24 of defendants' exhibits; article from Central Blatt, No. 27, September, 1852, pages 449 to 451, marked No. 25 of defendants' exhibits; article in same periodical, 15 December, 1852, p. 499, marked No. 28 of defendants' exhibits; article from the Industrie Austellung, zu London, 1851, Th. II, pages 329 to 342, marked No. 26 of defendants' exhibits; article from the Verhandlung des Verein's sur Befondering des Gewerbfleisches in Preussen, Berlin, 1846, vol. 25, page 228, marked No. 29 of defendants'
147 exhibits; English patent of Lemuel Wright, dated 1843, June 15, No. 7,987, marked No. 20 of defendants' exhibits; letters patent of the United States, Lemuel W. Wright, March 27, 1847, marked No. 21 of defendants' exhibits; French patent of Ladet, August 7, 1854, marked No. 42 of defendants' exhibits; French patent of Coupier and Mellier, May 17, 1851, marked No. 46 of defendants' exhibits; English patent of A. Mellier, May 2, 1855, sealed October 26, 1855, marked No. 44 of defendants' exhibits; English patent of John Jeyes, October 3, 1854, marked No. 32 of defendants' exhibits; American patent of William Magaw, Meadville, March 8, 1828, May 22, 1828; English patent of Watt and Burgess, dated August 19, 1853, marked No. 34 of defendants' exhibits; article from Central Blatte, No. 29, November 15, 1852, p. 483, marked No. 23 of defendants' exhibits? And if so, state whether such patent is the same, or substantially the same, as the Mellier

patent, or whether such patent or article describes a process the same, or substantially the same, as that described in the Mellier patent; and if not, state why not, and state fully the differences between them.

A. I have read, examined, and am familiar with the patents and articles referred to in the above question. As to the French patent of Clothan Breuil, February 12th, 1846, No. 18 of defendants' exhibits, my remarks, in my answer to question No. 16, as to its bearing upon the Watt and Burgess reissued patents, equally apply to its bearing upon the Mellier patent.

As to the French patent of Sieur Gros, March 30th, 1847, No. 19 of defendants' exhibits, my remarks, in answer 17, as to its bearing upon the Watt and Burgess reissued patents, Nos. 1,448 and 1,449, equally apply to its bearing upon the Mellier patent. Mellier claims a pressure of between 70 and 80 pounds on the square inch, upon the inside of the boiler. Gros' highest pressure is 45 pounds.

As to the French patent of Sieur Mège, dated June 27th, 1845, No. 15 of defendants' exhibits, my remarks, in answer 18, as to its bearing upon the reissued patents of Watt and Burgess, Nos. 1,448 and 1,449, equally apply to its bearing upon the Mellier patent. The patentee does not use pressure.

148 As to the French patent of Sieur Roque, dated November 7th, 1845, No. 17 of defendants' exhibits, my remarks, in answer 19, as to its bearing upon the Watt and Burgess reissued patents, Nos. 1,448 and 1,449, equally apply to its bearing upon the Mellier patent. This patentee does not use pressure.

As to the French patent of Laforrest, Berryer, Son & Co., dated Nov. 24th, 1825, No. 5 of defendants' exhibits, my remarks, in my answer No. 20, as to its bearing upon the reissued patents of Watt and Burgess, Nos. 1,448 and 1,449, will equally apply to its bearing upon the Mellier patent. This patentee does not use pressure.

As to the French patent of Charles Wise, dated May 12th, 1838, No. 10 of defendants' exhibits, my remarks, in my answer No. 21, as to its bearing upon the reissued patents of Watt and Burgess, Nos. 1,448 and 1,449, equally apply to its bearing upon the Mellier patent.

As to the French patent of Sieur Bronzac, Chaptal et d'Arcet, December 30, 1824, No. 2 of defendants' exhibits, my remarks, in my answer No. 22, as to its bearing upon the reissued patents of Watt and Burgess, Nos. 1,448 and 1,449, equally apply to its bearing upon the Mellier patent. He does not use pressure.

As to the French patent of Sieur Chabert á Rouen, May 11th, 1839, No. 14 of defendants' exhibits, my remarks, in my answer No. 23, as to its bearing upon the reissued patent of Watt and Burgess, Nos. 1,448 and 1,449, equally apply to its bearing upon the Mellier patent. The patentee does not use caustic alkali, nor does he boil.

As to the patent of Montgolfier Freres, dated February 7th, 1838, October 5, 1838, October 16, 1838, marked No. 11 of defendants' exhibits, my remarks, in my answer No. 24, as to its bearing upon the reissued patents of Watt and Burgess, Nos. 1,448 and 1,449, equally to its bearing upon the Mellier patent. This patent more

closely resembles the Coupier & Mellier process than that of Mellier, since the Montgolfier completes the decomposition of the material, after boiling, by other chemical means. Mellier produces a pulp solely by the means of caustic alkali and the necessary temperature, and bleaches in the ordinary way with a small quantity of
149 bleach, while the Montgolfiers state that the ordinary mode of bleaching does not produce the desired effect on their product.

As to the patent of Seguin, dated 1806, marked No. 1, of defendants' exhibits, my remarks in my answer No. 26, as to its bearing upon the reissued patents of Watt and Burgess, Nos. 1,448 and 1,449, equally applied to its bearing upon the Meiller patent. This patentee does not boil under pressue.

As to the patent of Monier Legoux, March 12, 1839, marked No. 12 of defendants' exhibits, my remarks in my answer No. 25, as to its bearing upon the reissued patents of Watt and Burgess, Nos. 1,448 and 1,449, equally apply to its bearing upon the Mellier patent. This patentee uses soap and boracic acid in his operation.

As to the article from Berlage Central Blattes, No. 35, May 15, 1852, marked No. 24, of defendants' exhibits, my remarks, in my answer No. 27, as to its bearing upon the reissued patents of Watt and Burgess, Nos. 1,448 and 1,449, equally apply to its bearing upon the Meillier patent.

As to the article from Central Blatt, No. 27, September 1852, pp. 439 to 441, marked No. 25, of defendants' exhibits, my remarks, in my answer No. 28, as to its bearing upon the reissued patents of Watt and Burgess, Nos. 1,448 and 1,449, equally apply to its bearing upon the Mellier patent.

As to the article in the same periodical, 15th December, 1852, p. 499, marked No. 28, of defendants' exhibits, my remarks, in my answer No. 29, as to its bearing upon the reissued patents of Watt and Burgess, Nos. 1,448 and 1,449, equally apply to its bearing upon the Mellier patent.

As to the article from the Industrie Austellung, London, 1851, Th. II., pp. 329, to 342, marked No. 26 of defendants' exhibits, my remarks, in my answer No. 30, as to its bearing upon the reissued patents of Watt and Burgess, Nos. 1,448 and 1,449, equally apply to its bearing upon the Mellier patent.

As to the article from the Verhandlung des Verein's sur Befondering des Gewerbfleisches, in Preussen, Berlin, 1846, vol. 25, p. 228, marked No. 29 of defendants' exhibits, my remarks in my answer No. 42, as to its bearing upon the reissued patents of Watt and Burgess, Nos. 1,448 and 1,449, equally apply to its bearing upon the Mellier patent.

50 As to the English patent of Lemuel Wright, dated 1843, June 15, No. 7,987, marked No. 20 of defendants' exhibits, my remarks, in my answer No. 35, as to its bearing upon the reissued patents of Watt and Burgess, Nos. 1,448 and 1,449, apply equally as to its bearing upon the Mellier patent.

As to the letters patent of the United States, Lemuel W. Wright, March 27, 1847, marked No. 21 of defendants' exhibits, my remarks

in my answer No. 34, as to their bearing upon the reissued patents of Watt and Burgess, Nos. 1,448 and 1,449, apply equally as to their bearing upon the Mellier patent.

I have examined and am familiar with the French patent granted to Ladet, August 7, 1854, marked No. 42 of defendants' exhibits. The process is substantially the same as that of Mellier, and the date of the patent is the same.

I have examined and am familiar with the French patent granted, Coupier & Mellier, May 17, 1851, marked No. 46 of defendants' exhibits. In this patent the pulping is effected by the use of the hypochlorites, after a preliminary boiling in alkali at a low temperature not above 220° Fahrenheit. In the Mellier patent, pulping is effected directly by the action of caustic alkali at a temperature above 300° Fahrenheit.

I have examined and am familiar with the English patent of A. Mellier, May 2, 1855, sealed October 26, 1855, marked No. 44 of defendants' exhibits. It is substantially the same as the American patent of May 26, 1857.

As to the English patent of John Jeyes, March 31, 1854, marked No. 32 of defendants' exhibits, my remarks, in my answer No. 39, as to its bearing upon the reissued patents of Watt and Burgess, Nos. 1,448 and 1,449, apply equally as to its bearing upon the Mellier patent.

As to the American patent of Wm. Magaw, Meadville, March 8, 1828, May 22, 1828, not in defendants' exhibits, my remarks, in my answer No. 32, as to its bearing upon the reissued patents of Watt and Burgess, apply equally as to its bearing upon the Mellier patent.

As to the English patent of Watt and Burgess, dated August 19, 1853, marked No. 34, of defendants' exhibits, the description in the specification is defective in not giving specific directions as to
151 pressue of temperature. Mellier could not, from reading that specification, have learned that the temperature of "about 310° Fahrenheit or a pressuee of 70 to 84 pounds on the square inch inside the boiler," was required to produce the required result. The strength of alkali used is different in the two patents. Mellier's process is not adapted to wood, but only to straw and similar fibrous materials.

As to the article from Central Blatte, No. 29. November 15, 1852, page 483, marked No. 23, of defendants' exhibits, I have examined, read and considered it. It merely refers to the Donkin boiler for rags, and the pressure claimed is only 1½ atmospheres. It does not describe or suggest the Mellier patent.

Q. 47. Have you read, examined and considered the article from the Fabrication de Papier by Pieltes, published in 1861, vol. 1, page 21, marked No. 40, of defendants' exhibit? And if so, state whether such article describes an apparatus the same, or substantially the same, as that described in the patent of Morris L. Keen of September 13, 1859, and if not, state why not, and state fully the difference between them.

A. I have read, examined and considered the article form the

Fabrication de Papier by Pieltes, published in 1861, page 21, marked No. 40 of defendants' exhibits. It does not describe an apparatus substantially the same as that described in the patent of Morris L. Keen, of September 13, 1859. It is a notice of two varieties of boilers for rags: one is horizontal, and heated by direct heat; the other vertical, and heated by steam. In the vertical boiler the opening for the delivery of the product is at the bottom; in the horizontal boiler at the end. In both cases the steam and liquid are blown out previous to the opening of the man-holes to let or draw out the contents of the boiler. These boilers, therefore, differ materially from Keen's, in that the whole contents of Keen's boiler are gradually blown out when under pressure; while in those referred to above, the steam and liquid being first blown out, the solid contents are allowed to escape and the contents to fall out or are drawn out.

Q. 48. Have you read, examined and considered the article from Verhandlung des Verein's sur Befondering des Gewerbfleisches, Berlin, 1846, vol. 25, p. 228, marked No. 29, of defendants'
152 exhibits? And if so, state whether such article describes an apparatus the same, or substantially the same, as that described in the patent of Morris L. Keen, September 13, 1859; and if not, state why not, and state fully the difference between them.

A. I have read, examined, and considered the article from Verhandlung des vereins sur Befondering des Gewerbfleisches, Berlin, 1846, vol. 25, p. 288, marked No. 29, of defendants' exhibits. It is merely a description of the ordinary covered iron kettle provided with a false bottom for boiling rags. It especially states that the rags are put in and taken out at the top. It in no respect resembles Keen's boiler.

Q. 49. Have you read, examined, and considered the article from the Fabrication de Papier, Dr. L. Muller, 2d edition, Berlin, 1855, p. 32, fig. 1, marked No. 38 of defendants exhibits? and if so, state whether such article describes an apparatus the same, or substantially the same, as that described in the patent of Morris L. Keen, September 13, 1859; and if not, state why not; and state fully the difference between them.

A. I have examined, read and considered the article from the Fabrication de Papier, Dr. L. Muller, 2d edition, Berlin, 1855, p. 32, fig. 1, marked No. 38 of defendants' exhibits. It is merely a description of the boiler mentioned by Pieltes.

Q. 50. Have you examined and are you familiar with the patent granted to Lemuel Wright, dated March 27, 1847, marked Nos. 20 and 21, of defendants' exhibits? and if so, state whether such patent is for the same, or substantially the same, apparatus as that described and claimed in the patent of Morris L. Keen of September 13, 1859; and if not, state why not, and state fully wherein the Keen patent differs from the above-mentioned patent of Lemuel W. Wright, and in what respects they are distinct and seperate inventions.

A. I have examined said patent, and it differs from that of Morris L. Keen. Wright's boiler is a perpendicular one, and he removes the vegatable material under process from this boiler into another

vessel, placed at a higher level, by admitting steam above the mass of the pulp in the boiler; the pressure of this steam forces the pulp out of an opening in the bottom of the boilers and through a pipe into the vessel at a higher level. Wright merely employs pressure of steam to remove his already mechanically broken down
153 material from the boiler. As his boilers are of large diameter, and not stayed, it is evident that he does not use much pressure. I do consider that the boilers figured in the drawing attached to his specification could be worked, or were intended to be worked, at a pressure above two atmospheres. He does not blow out under pressure for the purpose of opening out his previously distintegrated material. Wright's patent differs from Keen's in having no expansion chamber or perforated diaphragm. Wright's boiler is merely an ordinary boiling vessel, fitted with a cock and a pipe to carry the contents into a washing vessel by the pressure of steam brought from a second boiler. Keen's boiler is constructed especially for the purpose of boiling its contents under a high pressure of steam, and of gradually discharging these contents under such pressure, so as mechanically to open out and separate the individual fibre from which the interstitial matter has been previously removed by chemical action, thus facilitating percolation. The effect of boiling wood in caustic alkaline solutions of proper strength and at a proper temperature is to remove the intercellulose; but the form of pieces of wood so acted upon is not much changed, and if the contents of the boiler were discharged in the ordinary way, some mechanical action would be necessary to open out these soft pieces. In the discharge under pressure, as employed by Keen, this opening out is rapid and complete.

Q. 51. Have you read, examined, and considered the article from the Journal des Fabricats de Papier, vol. 5, p. 34, marked No. 39, of defendants' exhibits? and if so, state whether such article describes an apparatus substantially the same as that described in the patent of Morris L. Keen, September 13, 1859; and if not, state why not, and state fully the difference between them.

A. I have read, examined, and considered the article from the Journal des Fabricats de Papier, vol. 5, p. 34, marked No. 39, of defendant's exhibits. It is merely a description of the horizontal boiler noticed by Pieltes.

Q. 52. Have you examined and are you familiar with the patent granted to A. S. Lyman, August 3, 1858, marked No. 36, of defendants' exhibits? and if so, state whether such patent is for the
154 same or substantially the same apparatus as that described and claimed in the patent of Morris L. Keen, September 13, 1859; and if not, state why not, and state full wherein the Keen patent differs from the above-mentioned patent of A. S. Lyman, and in what respects they are for distinct and separate inventions.

A. I have examined and am familiar with said patent. Lyman's boiler discharges its contents suddenly—whence its popular name of the gun process. The object of this sudden discharge is to mechanically rip apart, as far as possible, the fibres of the material used

which are afterwards to be submitted to chemical action. In Keen's boiler, the pulpy mass previously disintegrated by a chemical action is gradually forced out of the boiler. Lyman's boiler could not be employed, in the manner described in his patent, for producing pulp under the reissued Watt and Burgess patent, or the Mellier patent.

Q. 53. Have you read, examined, and considered the article from Central Blatte, No. 29, 15th November, 1852, p. 483, marked No. 23, of defendants' exhibits? and if so, state whether such article describes an apparatus the same or substantially the same as that described in the patent of Morris L. Keen, September 13th, 1859; and if not, state why not, and state fully the difference between them.

A. I have read and examined the article above refered to. It refers Donkin's boiler for rags, which contains no expansion chamber and does not discharge its contents by pressure of steam.

Q. 54. Have you read, examined and considered, and are you familiar with, the following patents and articles referred to on p. 11, of defendants' answer, namely: Fabrication de Papier, by Pieltes, 1861, p. 21, marked No. 40, of defendants' exhibits? Verhandlung des Vereins, Berlin, 1846, vol. 25, p. 228, marked No. 29, of defendants' exhibits; Fabrication des Papiers, Dr. L. Muller, 2d edition, Berlin, 1855, p. 32, fig. 1, marked No. 38, of defendants' exhibits; English patent, Lemuel Wright, June 15, 1,843, No. 7,987, marked No. 20, of defendants' exhibits; American patent, Lemuel Wright, March, 27, 1849, marked No. 21, of defendants' exhibits, and American patent A. S. Lyman, August, 1858, marked No. 155 36, of defendants' exhibits; Journal des Fabricats de Papier, vol. 5, p. 34, figures 29 and 30; Paris and Arden, November, 1858, marked No. 39, of defendants' exhibits; Central Blatte, No. 23, 15 November, 1852, p. 483, marked No 33, of defendants' exhibits? and if so, state whether such patents or such articles describe an apparatus the same or substantially the same as that described in the patent of Morris L. Keen, of June 16, 1863; and if not, state why not; and state fully the difference between them.

A. I have examined the articles and patents referred to on page 12, of defendants' answer, and am familiar with the same. My remarks as to their bearing upon the patent of Morris L. Keen, of September 13, 1859, apply equally as to their bearing upon the patent of Morris S. Keen, of June 16, 1863.

OCTOBER 31, 1866.

Present: Counsel for respective parties.

Q. 55. In any of the patents and articles referred to in your previous testimony which were published prior to 1853, do you find a description of a pulp produced by chemical agency alone suitable for paper making without admixture?

A. I do not.

Q. 56. Can you divide the supposed inventions described in the patents and articles published prior to 1853, into classes or groups according to their characteristics? if so, state how such classes or groups may be composed and described, and in what essentials they differ from the reissued Watt and Burgess, and the Mellier inventions.

A. They may be so divided or classified.

1st. Into those which do not use or refer to the use of caustic alkali at a total internal pressure from 70 to 84 pounds (Mellier patent,) or a temperature at, near, or above 300° F. (Watt and Burgess re-issue,) namely: The processes of Clothan Breuil, Feb. 12th, 1846, defendants' exhibit No. 18. Mege, June 27th, 1845, marked No. 15, of defendants' exhibits. Roque, 7th November, 1845, marked No. 15, of defendants' exhibits. Berryer, November 24th, 1825, marked No. 5, of defendants' exhibits. Bronzac Chaptal et D'Arcet, 30th December, 1824, marked No. 2, of defendants' exhibits. Chabert a Rouen, May 11th, 1839, marked No. 14, of defendants' exhibits. Seguin, 1801, marked No. 1, of defendants'
156 exhibits. Monier Legoux, 12th March, 1839, marked No. 12, of defendants' exhibits. Lemuel W. Wright, patent, 15th June, 1843, marked No. 20, of defendants' exhibits. American patent, Lemuel W. Wright, 27th March, 1847, marked No. 21, of defendants' exhibits. Coupier and Mellier, 17th May, 1851, marked No. 46, of defendants' exhibits. United States patent, 2d August, 1853, re-issue of the same, marked No. 33, of defendants' exhibits. Patent of William Magaw, 8th March, 1838, not in defendants exhibits. Patent, Louis Lambert, 1826, marked No. 3, of defendants' exhibits. Verdandlung des Vereins, vol. 25, pp. 22, 28, marked No. 29, of defendants exhibits. Berthollet on Dyeing, p. 126, marked No. 43, of defendants' exhibits. Central Blatt, No. 29, 15th November, 1852, marked No 23, of defendants' exhibits. Patent of Dubouchet, marked No. 16, of defendants' exhibits. Handbook of paper manufacture, No. 7, of defendants' exhibits.

2d. Into those which do not use or refer to use of wood, straw or other similar vegetable substances, excluding those named in class first, to wit: Central Blatte, No. 35, May 15th, 1852, marked No. 24, of defendants' exhibits. Extract from Silliman's Journal, defendants' exhibit No. 6, Edinburgh Encyclopædia, marked No. 8, of defendants' exhibits.

3. Patents for apparatus only, namely: of Charles Wise, 12th May, 1838, marked No. 10, of defendands' exhibits. Of George Spofford, 27th December, 1840, marked No. 13, of defendants' exhibits.

4th. Those in which the statements are indefinite, or are on insufcient authority, namely, Central Blatte, No. 27, September, 1852, marked No. 25, of defendants' exhibits. Industrie Austellung zu London, 1851, marked No. 26, of defendants' exhibits. Central Blatte, No. 15, December, 1862, marked 28, of defendants' exhibits. Encyclopædia Brittanica, vol. v., 1810, marked No. 9, of defendants' exhibits.

5th. Those processes, excluding those previously classified, in which the intercellulose was evidently not removed by chemical means, namely: Gros, 20th March, 1847, marked No. 19, of defendants' exhibits. Montgolfier Freres, 7th February, 1848, marked No. 11, of defendants' exhibits.

Q. 57. Have you examined the boilers and apparatus de-
157 scribed in the patents and articles referred to in the defendants answer, as applicable to the patented boiler of Morris L.

Keen? and if so, state whether you find substantially the same invention in any of them.

A. I have examined said boilers and apparatus, and have not found substantially the same inventions as the Keen boiler in any of them.

Q. 58. Do the temperatures and pressures of the Mellier specification correspond? and if not, please explain the discrepancy.

A. The temperature and the pressure in the Mellier specification do not apparently correspond. He says: "A pressure internally of the boiler, equal to or exceeding seventy pounds, that is, 300° F."

In my answers, where temperatures and pressure have been referred to, I have spoken generally of steam pressures as ordinarily read from the guages or safety-valves, that is, the pressure above that of the atmosphere. The total internal pressure is, of course, about fifteen pounds greater; that is, the guage pressure plus that of the atmosphere.

Making this allowance, and bearing in mind the fact that the French standard of atmospheric pressure is fourteen and seven-tenths pounds, we find that if we assume five atmospheres as his pressure, it would correspond to a total internal pressure of 73.5 pounds, or a safety-valve pressure of 58.8 pounds.

The temperature corresponding to 58.8 pounds steam pressure, as read by the guage or safety-valve is, with an alkaline solution of 2° B., and wood in proper proportion, as stated in answer 15, about 310° F. I have not determined the temperature at about that pressure with straw and alkali, but do not believe that it would materially differ from that given above.

Q. 59. Have you examined and are you familiar with the patent granted to Dubouchet, 28th September, 1840, marked No. 16, of defendants' exhibits? and if so, state whether such patent is for the same, or substantially the same, process as that described and claimed in reissued patent No. 1,449, (the Watt and Burgess patent,) and whether the article produced is the same, or substantially the same as that described in re-issued patent No. 1,448, for a new manufacture, and if not, state why not, and state fully wherein the re-issued patent
158 differs from the above-mentioned patent of Dubouchet, and in what respects they are for distinct and separate inventions.

A. I have examined and am familiar with said patent. It differs from the reissued patents 1,448, 1,449, and from the Mellier patent. The patentee first gives direction for rendering commercial alkali caustic. He uses crystals of carbonate of soda, sal soda. The vegetable materials, for instance, reeds, are held submerged by an iron grating which may be operated by a pulley. He uses 60 per cent. of a solution of caustic soda at 20° B., and subsequently adds lime, to render caustic any alkali which may have reabsorbed carbonic acid during the operation. It is subsequently treated with dilute hydrochloric acid, washed and bleached.

He states that the boiling may be done directly over the fire or by steam. If steam be used, and the material subjected to a pressure of three atmospheres, the operation is shortened, but he does not say that the product is improved in quality.

Q. 60. Have you read, examined, and considered the following

articles: Extract from Silliman's Journal, January, 1827, marked No. 6 of defendants' exhibits; extract from the Edinburgh Encyclopædia, vol. iii., 1832, marked No. 8 of defendants' exhibits; extract from Handbook, on paper manufacture, 1835, marked No. 7 of defendants' exhibits; extract from Encyclopædia Britanica, vol. v., 1810, marked No. 9 of defendants' exhibits; extract of catalogue of World's Fair, 1851, marked No. 22 of defendants' exhibits; extract from Regnault's chemistry, 1852, p. 446, marked No. 37 of defendants' exhibits? and if so, state whether such article describes a process substantially the same as that described in the Watt and Burgess patents, and in the Mellier patent; and if not, state why not, and state the difference between them.

A. I have examined, read, and considered the extracts named:

In Silliman's Journal, the writer speaks of the advantage of boiling the cotton and linen fabrics in alkali under pressure, as a preparatory process to the bleeching, over that of steaming or bucking; the writer speaks of a pressure corresponding to 230° F. The object here is to cleanse, not to disintegrate.

The writer in the Edinburgh Encyclopædia, vol. iii., 1832,
159 in an article on bleaching, states that the goods are steeped in caustic alkali, ground and exposed to steam pressure in a closed boiler; no particular pressure is named. The object of the process is to cleanse, not to disintegrate.

In the Handbook of Paper Manufacture, 1835, the writer refers to the boiling of straw in a caustic alkaline lye, and steaming. He does not refer to a closed vessel or to pressure.

In the Encyclopædia Britanica, vol. v., 1810, the only statement bearing on this case is, that reducing straw to a pulp is more a chemical than a mechanical process.

In the report of the World's Fair, 1851, is a notice in the catalogue of the exhibition of specimen of straw paper by Lemuel Wellman, Wright & Co.

In the extract from Regnault's Chemistry, American ed., 1852, p. 446, after describing the structure of the wood, the author refers to the method of preparing cellulose by the action of hot caustic alkali, and subsequent treatment by hydrochloric acid, or by the action of chlorine or the hypochlorites, followed by alkali and dilute hydrochloric acid. He does not mention pressure; and the process named would not, I think, produce pure cellulose from ordinary wood or straw.

The other patent and articles referred to in the defendants' exhibits are of subsequent date to that of the Watt and Burgess and Mellier patent, and do not refer in any way to that of Keen.

Q. 61. In your answer to interrogatories No. 13, No. 45, you refer to certain tables, showing pressures and temperatures and the results of your experiments in pulping wood by chemical means: please now produce those tables for annexation, as Exhibits A and B of your testimony; also please furnish specimens of the products of the various operations referred to in the said tables.

Witness here produces two tables and specimens, marked A and B, of Dr. Rand's testimony, and bottles marked Nos. 1, 3, 4, 5, 6, 7, 10, 12, 13, 22 and 23.

160 *Exhibit A, of Dr. Rand's testimony.*

Temperatures and Pressures.

DISTILLED WATER.			SOLUTION OF CAUSTIC ALKALI AND INTER-CELLULAR TISSUES. (Rand & Cresson, 1866.)		
Pressure. lbs.	Sewell. 1852.	Rand & Cresson. 1866.	2° Beaume.	5° Beaume.	12° Beaume.
30	276.4	276.	276.5	277.75	280.
32	279.2	278.5	279.	280.	284.
34	281.6	281.	282.	283.	286.5
36	284.4	283.	284.5	286.	289.
38	286.9	286.	287.25	288.	292.
40	289.3	288.25	290.	291.5	294.
42	291.7	291.5	292.	293.75	296.
44	294.2	293.75	294.75	296.25	299.
46	296.9	296.	297.	298.	302.
48	299.2	298.	299.	301.	304.
50	301.3	300.	301.50	302.75	306.
52	303.3	303.	303.75	304.75	308.
54	305.4	304.5	305.25	307.	310.
56	307.4	306.75	307.	309.	312.
58	309.3	308.5	309.	311.	314.
60	311.2	310.5	311.	313.	316.
62	313.1	312.25	312 5	314.75	318.
64	314.9	314.25	314.25	316.25	
66	316.7	316.	316.25	318.	
68	318.4	317.	318.	320.	
70	320.1	319.	320.	321.50	326.
72	321.8	320.50	321.	323.	
74	323.5	322.+	322.75	324.	
76	325.1	324.	324.50	326.	
78	326.7	325.50	326.+	327.50	
80	328.2	327.	327.75	329.	337.
82	329.8	328	328.75	330.25	
84	331.3	330.	330.+	332.	
86	332.9	331.50	331.75	333.25	
88		332.75	333.+	335.25	
90	336.5	334.	334.25	336.25	343.
92		335.	336.	337.50	
94		336.50	337.	339.	
96	340.	338.	338.25	340.25	
98		339.	339.75	341.50	
100	342.5	340.50	341.	343.	349.
110	348.9	346.50	347.		354.
120	355.	352.	353.		363.
130	360.6	357.5	358.		368.
140	366.	363.25	364.		373.
150	371.1	368.25	369.		378.
160	376.	372.75	373.		382.
165	378.4	375.	377.		384.
170	380.6	377.50	380.		385.50
180	385.1	382.	384.		390.
190	389.3	386.	388.		394.
200	393.4	390.	392.		398.

Exhibit B of Dr. Rand's Testimony

No. of experiment.	Weight of Wood.	ALKALI. Caustic Alkali.	Water for dilution.	Grains caustic soda.	Specific grav., Beaume.	P'r c't caust alk. to wood	Per c't caust. alk. to pulp	P'r c't of caust. alk. to proper p'r c't of pulp.	Sp. gr. resultant liquid.	HEAT. Temp in boil'r Fahr'nh't	Correspond'g pres're in lbs.	Hours under boil.	PRODUCT. Weight of pulp.	P'r c't of pulp to wood.
	grs.								○	○			*grs.*	
1	5250	36 f℥	.....	945	11¾	18	60	60	21	384	165	1	1577	30
3	5250	36 f℥	36 f℥	945	5	18	47.9	51.1	...	380	165	1	1971	37.5
4	5250	f℥ f℥ m 27 6 24	32 f℥	756	5	14.4	35.2	41	8	376	160	1	2145	40.8
5	5250	18 f℥	54 f℥	472	2.8	9	17.5	25.5	...	378	165	1	2695	51.3
6	5250	36 f℥	36 f℥	945	5½	18	29.7	51.1	7	313	60	1	3181	60.6
7	5250	36 f℥	36 f℥	945	5½	18	33.2	51.1	8	313	60	2	2840	54
10	5250	f℥ f℥ m f℥ f ℥ m 25 1 26	46 6 24	662	3½	12.6	28.2	35.82	6	379	165	2	2345	44.6
11	5250	72 f℥	.....	1890	11¾	36	72.2	102.2	12	316	60	1	2617	49.8
12	5250	36 f℥	.....	945	11¾	18	51.3	51.1	24	384	165	1	1840	35
13	5250	36 f℥	36 f℥	945	5½	18	49	51.1	8	384	165	2	1930	36.7
22	1312	36 f℥	.....	945	11¾	72	192.4	204 4	...	311	55	7	491	37.7
23	1312	9 f℥	9 f℥	236	5½	18	36.9	51.1	...	303	50	16	740	48.7

Table of experiments upon Pulping Wood.

Experiments, where made and when. 1866.		GENERAL REMARKS AND RESULTS OF MICROSCOPIC OBSERVATIONS.
June 13, '66 at Am. Wood Paper Co.'s Works, Many'nk.	Normal.	Green wood fresh from chipping engine. Fibres perfectly separated; is entirely and immediately soluble in sulphuric acid. Colorless solution. Pure cellulose. Bleached.
June 20, '66, at No. 417 Walnut st., wood dry; chipped for boiler June 13, 1866.	Alkali diluted with equal bulk of water.	Fibres separated; soluble in sulphuric acid. Trace of color. Solution colorless. Bleached.
June 21, at No. 417 Walnut st.	Twenty per cent. of alkali off.	Fibres separated, but not entirely clear of encrusting matter. In sulphuric acid, light brown solution. Bleached.
June 21st, at No. 417 Walnut st.	Fifty per cent. of alkali off.	Chippy; fibres adherent; soluble in sulphuric acid; almost black. Would not bleach.
June 21st, at No. 417 Walnut st.	Normal amount of alkali but with reduced temperature.	Chippy; fibres not separated, apparently unaffected, except removal of dried sap. Solution of sulphuric acid black. Would not bleach.
June 22d, at No. 417 Walnut st.	Normal amount of alkali, with temperature reduced. Double time.	Chippy; similar in appearance to N s. 6 and 11. Sulphuric acid blackens. Would not bleach.
June 25th, at No. 417 Walnut st.	Thirty per cent. of alkali off. Double time.	Partially pulped, but chippy; resists sulphuric acid strongly; dark brown solution. Bleached.
June 25th, at No. 417 Walhut st.	Temperature off. Double alkali.	Similar in appearance to No. 6; sulphuric acid blackens. Would not bleach.
June 27th, at No. 417 Walnut st.	Normal solution and temperature, but with dry wood.	Fibres perfectly separated; is entirely and immediately soluble in sulphuric acid. Colorless solution. Pure cellulose. Bleached.
June 28th, at No. 417 Walnut st.	Alkali diluted, but with dry wood.	Fibres separated; soluble in sulphuric acic. Colorless solution. Pure cellulose. Bleached.
Sept. 4, '66, at No. 417 Walnut st.	Four times normal alkali. Temperature off. Soaked in alk. 35 hours. Boiled 7 times as long as Nos. 1, 3, 12.	Structure broken up, but fibres coated with encrust and adhering in bundles; not very flexible; dissolves in sulphuric acid, but makes a very brown solution. Very much resembles No. 4.
Sept. 5, at No. 417 Walnut st.	Normal alkali; temperature off; soaked in alkali 98 hours; boiled 16 times as long as Nos. 1, 3, 12.	Structure broken up, but fibres coated with encrust; dissolves in sulphuric acid, but makes a brown solution.

162 *Cross-examined.*

By Mr. Harding for defendants:

Q. 1. What practical experience or acquaintance have you had in the manufacture of paper or paper pulp?

A. Only that obtained by visits to the works of the American Wood Paper Company, and experiments made during last summer and fall.

Q. 2. When, and how often, did you visit the works of the American Wood Paper Company?

A. I think I visited the works five times. I cannot give the dates; but during 1866.

Q. 3. On what kind of material were they operating when you visited the works?

A. In one department on poplar wood, in another on straw.

Q. 4. Are those the only materials you have ever seen practically operated upon in the manufacture of pulp?

A. In the straw mill some rags and rope were being made into pulp, also for the purpose of admixture. These are all the materials that I have seen operated on.

Q. 2. Describe so that a person acquainted with the art of paper-making could carry out the process of making white paper from the log of poplar wood, as you saw it done.

A. The log is freed from its bark, cut into chips by revolving blades driven by water power. 2d. The chips are put into vertical boilers provided with a man-hole at the top, and a perforated diaphragm at a short distance below the top, with a blow-out; the object of the diaphragm is to keep the wood submerged in the alkaline solution which is afterwards added, and at the same time to allow of the expansion of the liquid by heat. At or near the bottom of the boiler is a valve or cock, by means of which its contents may be discharged. The chips having been put into the boiler, a warm solution of caustic soda of a strength of about 12° Beaumé is introduced so as to cover the chips. The exact quantity used will depend upon the dryness or greenness of the wood, a less quantity being required for green than dry wood. Sixty per cent. of the weight of the dry pulp is the quantity of caustic soda used; one-third of this quantity will be the average amount required for wood, that is, 20 per cent. of the weight of the wood in caustic soda. The solution of caustic soda is

163 prepared as follows: Soda-ash, that is commercial carbonate of soda, is dissolved in water in the proportion of a pound to the gallon, and boiled with half its weight of good lime previously slacked. I do not remember the length of time that the boiling is kept up at the works; a very simple test, however, shows when the operation is completed. If a few drops of acid be added to a portion of the solution and no effervescence occur, the liquor is caustic. The carbonate of lime formed during the operation is allowed to settle, and the clear alkaline liquid raised by centrifugal pumps up into a tank which is above the boilers, where it is warmed by the waste heat.

(Mr. Harding here states that he wishes the witness to state those things which he deems essential to be known.)

From these tanks it is led into the boilers by a hose. The boilers being charged, fire is applied until a pressure of a hundred and sixty to a hundred and seventy pounds, and sometimes higher is attained. I ascertained this pressure by measurement of the safety-valve. The workmen regulate the degree of the fires by the pressure-gauges attached to the boiler. The materials are kept under this pressure for five hours, the fires are then withdrawn, the discharge-valve at the bottom of the boiler opened, and the contents blown out into a suitable vessel. The blowing out requires from two to four minutes. The product is placed in cars with perforated bottoms, and washed with hot water, (the washings are saved, evaporated to dryness and calcined in a reverberatory furnace; the result is a mixture of charcoal, carbonate of soda, with some caustic soda probably. This is bleached, and the soda may be again used; a certain portion is always lost during the operation.) The material, after washing, is taken to the beating engine—an ordinary rag-beating engine, as I understood, modified by having the points on the heating cylinder blunt instead of sharp. I don't know how long it was in the beating engine, but I was informed a short time. It is then pumped into a bleach vat, and then submitted to the action of a bath of chloride of lime, containing 15 per cent. of the chloride to the dry pulp, or about 5 per cent. to the original amount of wood. The bleached pulp is now washed, and submitted to a prolonged beating in the rag-
engine. This prolonged beating is found to enable it to hold
164 water, as it is termed, when passing over the wire of the
paper-making machine; it is then made into paper by the usual process.

Q. 6. What would be the effect of using a less proportion of caustic soda?

A. The intercellular matter would not be wholly removed. The yield would be larger, but the material less adapted to paper-making.

Q. 7. In order to carry on the process properly, it is not necessary to know the quantities of soda proportionate to the quantity of material treated?

A. It is necessary, but when in doubt, from any cause, (as from greenness or dryness of wood,) it is always safe to use an excess.

Q. 8. The quantity set forth by you, to wit, 20 per cent. caustic soda to weight of wood, is the quantity requisite for wood in its average condition?

A. It is slightly in excess of the requisite quantity.

Q. 9. Was that not the usual proportion which you understood to be used at plaintiffs' works?

A. It was.

Q. 10. What would be the effect of reducing the time of boiling the wood from five hours down? and what would be the effect of increasing the time from five hours up, at the plaintiffs' works?

A. I did not see any boiling made there of less than five hours from the time of firing; but, from experiments on a small scale, I believe

that by diminishing the time the chemical action would be incomplete; some portions of the wood would be disintegrated, and other portions not. In boiling under pressure, there is no bubbling; it is more of a soaking action, and requires time. When a substance is boiled in an open vessel, the agitation of the liquid moves the body, if a solid, in various directions, thus facilitating the action of the liquid upon it. This is not the case when boiling under the pressure. An increase of time, provided there were no excess of alkali, would, I think, make no difference; but if there were an excess of alkali, prolonged boiling would act on the cellulose, and the yield would be diminished.

Q. 11. What would be the effect of diminishing the pres-
165 sure from 160 pounds? and what would be the effect of increasing it above 160 pounds?

A. Diminishing the pressure renders necessary a longer boiling; below 50 pounds satisfactory chemical action would not take place. Increasing the pressure above 160 pounds, would, I believe, shorten the process; but I do not say this from experiment or observation.

Q. 12. Would satisfactory results take place by boiling at a pressure of 50 pounds? and what do you mean by satisfactory results in your last answer?

A. By prolonged boiling, with an excess of alkali, at 50 pounds pressure, a pulp may be obtained, but not of good quality. That is, the intercellular matter is not entirely removed. By satisfactory results, I mean obtaining a pulp which might be made into paper without admixture. I speak, in this answer and in the last—in fact, in all these answers—of the action of caustic alkali upon wood chips.

Q. 13. What would be the effect of reducing the pressure below 50 pounds, and increasing the quantity of alkali and time of boiling?

A. I made no experiments between atmospheric pressure and 50 pounds. My opinion is that, as we diminish the pressure, less of intercellular matter is removed.

Q. 14. Did you find, in your experiments from 160 pounds pressure down to 50 pounds, that, as you diminished the pressure, you had to increase the time and increase the quantity of alkali, and that the amount of intercellular matter removed diminished?

A. I did.

Q. 15. Is it not your opinion that boiling wood in caustic alkali for a prolonged time, at a temperature of 230°, would remove some of the intercellular matter?

A. I think that it would.

Q. 16. Is it not your opinion that, as the temperature is increased above 230°, that the amount of intercellular matter removed would be increased in proportion to the increase of temperature up to 376°, (the temperature equivalent to 160 pounds pressure.)

A. I think that it would; the intercellulose varies greatly in
166 its resistance to chemical agents. That which incrusts the fibre proper is the most difficult of oxidization, and requires high temperatures.

Q. 17. Do you know at what temperature that which incrusts the fibre is removed?

A. It is removed at 160 pounds pressure; but at what lower I cannot state. I know it is removed at 160 pounds pressure, 370° temperature, and I know it is not entirely removed at 50 pounds pressure, or 303 degrees of temperature, but some of it is; but what intermediate point between these it is entirely removed, I cannot ay; there probably is a point, but I cannot fix it.

Q. 18. What do you mean by the expression it "requires high temperature to remove the intercellulose that incrusts the fibre proper," in your sixteenth answer? What temperature had you in your mind when you gave that answer?

A. About 300° Fahrenheit.

Q. 19. Why do you fix 300° Fahrenheit as the minimum at which that incrusting matter can be removed, instead of 280°?

A. In an experiment made at 313°, the incrust was not removed; and therefore, I state that the temperature must be above 300°.

Q. 20. Then you can fix no point between 373° and 306° of temperature, as the minimum point at which this incrust will be removed?

A. I cannot.

Q. 21. What effect on the weight of the product, and upon its character as a pulp, has the presence of this intercellulose, which incrusts the fibre proper, referred to in your sixteenth answer?

A. It will increase the weight of the product and render the fibres less pliable.

Q. 22. Can you fix the minimum point of temperature at which the product is thirty per cent. of the wood, and when the fibres are flexible, thoroughly detached from each other, pliable, and capable of felting together?

A. The minimum point I cannot fix; but such product will be obtained at 155 pounds pressure, corresponding to 384° degrees of temperature. This is the lowest my own experiments fix.

Adjourned till April 25, 1867, at 10 a. m.

APRIL 25, 1867.

Adjourned till May 2, 1867, at 10 a. m.

167 MAY 2d, 1867.

Present: Messrs. Harding, Wallace, and Dr. Rand.

Q. 23. Has pressure anything to do with the conversion of wood into pulp, except so far as it necessary to preserve the liquid state under the increased heat?

A. It has not.

Q. 24. Are not heat and caustic alkali and water the only essential requisite in the conversion of wood into pure pulp or cellulose?

A. I presume that they are; but we have made no experiments on the subject.

Q. 25. Can you not, by increasing the strength of your solution of caustic alkali, obtain a heat of 360°, the solution remaining liquid without pressure?

A. Yes.

Adjourned to May 13th, 1867.

MAY 13th, 1867.

Present: Messrs. Wallace, Harding, and Dr. Rand.

Q. 26. You have defined, in answer twelve (in chief) the necessary fibres requisite for the manufacture of paper as those fibres which are flexible, thoroughly detached from each other, pliable, and capable of felting or matting in the production of such fibres, as the features of reissues 1,448, 1,449?

A. Yes; I understand the nature of the invention described in 1,448 and 1,449 was the production of such fibres.

Q. 27. With a sufficient amount of caustic alkali, does not the amount of intercellulose removed, and the purity of the pulp produced, increase with the increase of temperature from 212° Fahrenheit upwards?

A. In my judgment, the amount of intercellulose removed, and the purity of pulp produced does increase with an increase of tem-
168 perature from 212° Fahrenheit upwards; but I do not know in what proportion it increases correspondingly with the increase of temperature. I made no experiments above 390° Fahrenheit; and up to that point the amount of intercellulose removed did increase with the increase of temperature.

Q. 28. Is there not intercellulose in unbleached linen? And when unbleached linen, or unbleached linen rags, are boiled in caustic alkali under pressure preparatory to being bleached or made into paper, is not a portion of this intercellulose removed?

A. There is intercellulose present, and a portion is removed by the preliminary boiling in caustic alkali.

Q. 29. Prior to 1853, were there not two chemical processes laid down in the books for obtaining cellulose from wood—one by boiling wood in caustic alkali, then reacting by chlorine, and again reacting by caustic alkali; and another chemical process, described by boiling the wood with a solution of caustic alkali alone, the temperature being increased in the latter case to a high degree by the increasing density of the solution?

A. There were. Dumas, in his "Traite du Chimie," Paris, 1843, vol. 6, p. 17, describes these two processes. Regnault's Chemistry, American edition, 1852, Philadelphia, describes the method of obtaining cellulose by the alternate action of hot caustic alkali and chlorine.

Q. 30. Does not Dumas draw the distinction between coniferous or resinous woods and other woods, so far that chlorine is necessary with the former, and may be dispensed with with the latter?

A. He does, at the reference last made.

Q. 31. Could not a temperature considerably above 300° be attained by boiling wood continuously in solution of caustic alkali in an open vessel? and how high a temperature could be obtained by boiling a solution of caustic alkali not under pressure?

A. Yes. Storer, in his Dictionary of Solubilities, p. 454, says that the saturated aqueous solution of caustic soda boils at 216° Cant.,

420° Fah. (T. Griffith. Quar. J. of Scien., 1825, v. 18, p. 91.)

169 Dalton's New System, part 2, p. 496: An aqueous solution of caustic soda:

Deg. Beaume.	Sp. gr.	Contains per ct. of Na. O.	Cent. Red heat.	Boils at Fah.
76	2.00	77.8		
70	1.85	63.6	315.56	600
64	1.72	53.8	204.44	400
59	1.63	46.6	148.89	300
55	1.56	41.2	137.78	280
51	1.50	36.8	129.44	265
49	1.47	34.	123.89	255
47	1.44	31.	120.	248
44	1.40	29.	116.66	242
40	1.36	26.	112.78	235
37	1.32	23.	108.89	328
34	1.29	19.	106.66	224
29	1.23	16.	104.44	220
23	1.18	13.	102.78	217
17	1.12	9.	101.11	214
9	1.06	4.7	100.56	213

Dalton remarks upon the table that "it will be found moderately accurate; but I could not give it the attention it deserves." I have converted the centigrade degrees in Storer to Fahrenheit.

Q. 33. In treating wood, does not the invention in the reissued patents Nos. 1,448 and 1,449, relying upon a single direct action of caustic alkali alone, require a certain percentage of alkali to the wood, and a certain minimum temperature to insure that result which would be obtained by the combined successive processes mentioned above, and is not the quantity of alkali required, and the temperature necessary in the two cases entirely different?

A. A certain percentage of caustic alkali to the wood, and a certain minimum temperature, are requisite to carry out the invention set forth in 1,448 and 1,449, and these are different from the quantity of alkali and temperature required in the process of treating wood successively with alkali, chlorine, and alkali again. The percentage of alkali to the wood required in the successive stage—alkali and hypochlorite process—is much less. To the extent that the
170 hypochlorites are used, the alkali required is less. The product obtained by the process of boiling wood in caustic alkali alone, at the proper temperature and strength, differs also in some of its physical properties from the product obtained by the successive treatment with alkali and chlorine, according to my experiments, and I presume there would be the same difference in the physical appearance of the product obtained by the successive action of alkali and hypochlorites.

Q. 33. In converting wood into pulp by boiling it in caustic alkali under pressure, when the temperature employed is sufficient to re-

move a large part of the intercellulose, but below that requisite to remove the incrusting matter referred to by you in your 17th answer, on cross-examination, would not that final incrusting matter be removed by a disintegrating action of the chloride taking place at the same time that the bleaching of the pulp took place, and consuming a certain portion of the chlorine by that disintegrating action.

A. The final incrust would probably be in great part removed by the chlorine, but not entirely. The product would not be of as good quality as that in which all the intercellulose has been removed by the alkaline treatment at a high temperature preliminary to a simple bleaching process.

Q. 34. If wood were treated with caustic alkali under pressure, at a temperature below 300°, and then bleached with chlorine, could not a fair result of white paper be obtained, although inferior in quality to that which would be obtained if a preliminary treatment, under a high temperature, with caustic alkali, had taken place?

A. Yes.

Q. 35. In all cases, must not the pulp obtained from wood be bleached by chlorine, or equivalent bleaching agent, before it can be made into white paper.

A. Yes.

Q. 36. Did you examine a portion of the specimens contained in the vial marked H. C. S. 21? if so; please state whether the incrusting matter was removed, and whether it would not require a further action of chlorine before it could be converted by simple bleaching into white paper.

A. The specimen appeared to be a pulp from poplar wood, which was not quite free from incrusting matter, and would therefore require a further disintegrating action of chloride, free or in combination, either before or as the time of its being bleached into white paper.

171

Q. 37. Can you draw any marked line of temperature below 360° as a point for the alkaline treatment, at which this subsequent disintegration by chloride would not be requisite in the converting of wood into white paper?

A. I cannot.

Q. 38. Can you name any specific chemical property, so far as disintegrating wood is concerned, which a caustic alkaline solution, at a temperature of 300° Fahrenheit, possesses, which is not possessed by a caustic alkaline solution at a temperature say 290° Fahrenheit?

A. Not having made any experiments below 306° Fahrenheit temperature, I cannot answer this question of my own knowledge; but I do not presume that there is any specific difference between the action that takes place at those two temperatures.

Q. 39. Have you examined the specimens of pulp contained in vial marked Exhibit H 4, C. S., at the examiner's office? and if so, please state whether the incrusting matter was removed, and whether it would not require a further action of chlorine before it could be converted by simple bleaching into white paper.

A. I examined said specimen; it is partially disintegrated straw, a considerable amount of the incrust still remains; whether it could be made into white paper I cannot say.

Q. 40. How did you come to select 160 pounds pressure, or 380° Fahrenheit temperature, as the lowest temperature at which you experimented with success in removing the incrusting matter, and making a pulp which could be bleached into white paper without a chlorine disintegration being required?

A. Because that was the temperature which I was informed at the plaintiff's works was the usual minimum temperature used at the American Wood Pulp Company's works, at Manayunk. The gauges used were blind, so that no stranger could tell the pressure from them; but I satisfied myself that such was the minimum pressure used by them.

Q. 41. Does not the French patent of Montgolfier Fréres, of 172 1838, defendant's Exhibit No. 11, describe a process of treating wood, by boiling in a caustic alkali, under pressure, as a preparatory process for making pulp for the manufacture of paper from such wood?

A. It does.

Q. 42. Do Montgolfier Frères fix limits to the pressures under which they boil vegetable matters in caustic alkali?

A. They do not.

Q. 43. After the boiling in caustic alkali under pressure, do not Montgolfier Frères provide for bleaching the pulp?

A. Yes.

Q. 44. Would not a temperature approximating 300° Fahrenheit be attained by boiling vegetable substances in a solution of caustic soap, according to Legoux's description in his French patent of 1839?

A. It would be within three or four degrees of that temperature.

Q. 45. Suppose you make a solution containing ten per cent. of its volume of soda-ash, and render it caustic by five per cent. of the solution of lime, what would be the strength of the caustic alkaline solution obtained?

A. It would be about 9° Beaumé, or 12° Twaddell.

Q. 46. Do not Dumas, Payen, and Labouillaye, and the writers on general chemistry, or on chemistry as applied to manufactures, so far as you have referred to them, treat "sel de soude" as meaning common soda-ash?

A. Yes; while in pharmaceutical works "sel de soude" is often referred to as crystalized carbonate of soda.

Q. 47. What would be the temperature of a solution of caustic soda of 9° Beaumé under a pressure of 44½ to 45 pounds?

A. It would be about 297° Fahrenheit.

Q. 48. Does not Gros, in his French patent, 1847, Exhibit 19, describe the treatment of wood with an alkaline solution rendered caustic under pressure, as a preparatory process for making pulp for the manufacture of paper?

A. He does.

Q. 49. Would not the pressure Gros names give a temperature of near 300° ?

A. It is within three degrees of it, with a caustic alkaline
173 solution of 5° Beaumé and wood. With a caustic alkaline solution of 12° Beaumé and wood, it would be within a degree of 300°.

Q. 50. After the pulp had been thus produced by Gros' process, does he not say it is to be bleached with chlorine or chloride of lime?

A. He does.

Q. 51. Does not Doubouchet, in his French patent, September 28, 1840, defendant's Exhibit 16, describe a process of treating vegetable substances by boiling in caustic alkali, under pressure, as a preparatory process for making pulp for the manufacture of paper ?

A. He does.

Q. 52. How high a temperature does he call for ?

A. About 280°.

Q. 53. By Doubouchet's process, after the pulp was made by boiling in alkali, was it not submitted to the bleaching process and then made into white paper ?

A. It was.

Q. 54. Does not Breuil, in his patent of February 12, 1846, describe a process of boiling vegetable substances in an alkaline solution, rendered very little caustic under pressure, as a preparatory process for making pulp for the manufacture of paper from such, vegetable substances ?

A. He does.

Q. 55. Does not Lemuel Wright, in his English patent of 1843, describe a process of boiling vegetable substances in caustic alkali, under pressure, as a preparatory process for the making of pulp for the manufacture of paper from such vegetable substances ?

A. He does.

Q. 56. Does Wright, in specific terms, limit his pressure ?

A. He does not.

Q. 57. After the pulp has been produced by the boiling in caustic alkali, does not Wright call for the bleaching of it by hypochlorite of lime, or chloride of lime as it is commonly called, to make white paper ?

A. He does.

Q. 58. What would be the temperature under which the
174 straw is boiled in strong lye, under pressure, according to the description contained in the Central Blatte of September 27, 1852, (Exhibit 25,) and the Industria Austellung of 1851, (Exhibit 65 ?)

A. It would be somewhat above 341° Fahrenheit.

Q. 59. Does not the French patent of Coupier & Mellier, of May 7, 1851, (Exhibit 46,) describe a process of treating wood, or other vegetable substances, by boiling in caustic alkali, under pressure, as a preparatory process for making pulp for the manufacture of paper from such wood or other vegetable substances ?

A. He does.

Q. 60. After being so treated, is not the pulp bleached by the action of hypochlorite of lime or alumina, so as to make white paper?

A. It is.

Q. 61. Do you consider the mode of making pulp from wood, or other vegetable substances, by boiling them in caustic alkali, under pressure, at a temperature of 230°, with a strength of 8° to 10° Beamé, (in 11° to 14° English hydrometer,) and then treating with hypochlorites, as described in Coupier & Mellier's patent, May 17, 1831, to be a substantially different invention from that contained in reissues 1,448 and 1,449?

A. I do consider it to be a substantially different invention.

Q. 62. What is the difference between the chemical action which takes place in the invention contained in Coupier & Mullier's patent of May 7th, 1851, and the inventions described in reissues 1,448 and 1,449?

A. In the invention described in reissues 1,448 and 1,449, the intercellulose is removed by the single action of caustic alkali at the high temperature named; at the lower temperature named by Coupier & Mellier, for boiling in caustic alkali, a portion of the intercellulose only would be removed by such boiling, and the remainder of the intercellulose would be oxidized by the hypochlorites, so as to be subsequently removed.

Q. 63. Do you consider the invention described in reissues 1,448 and 1,449 to be substantially different from the process described by Regnault, p. 446, Exhibit No. 37? and state wherein chemically it is a substantially different invention.

175 A. I do consider the invention described in reissues 1,448 and 1,449 to be substantially different from the process laid down by Regnault. In the process described in the reissues 1,448 and 1,449, the intercellulose is removed at a single operation, by boiling in caustic alkali at the temperature named. In Regnault's process a portion of the intercellulose is removed by a solution of an alkali at a temperature not necessarily above 212°, and the remainder by a treatment with chlorine or hypochlorites of lime, followed by a third treatment with alkaline solutions and a dilute hydrochloric acid; afterwards washed with alchohol and ether, to remove any fatty matter. This process, Regnault remarks, will also destroy a portion of the cellular tissue.

Q. 64. In the process of converting wood into cellulose by the successive action of caustic alkali; 2nd, of chlorine or hypochlorous acid; 3d, alkali; and 4th, of hypochlorous acid is boiling under pressure in the first stage consistent with the other stage of the process?

A. Boiling under pressure is consistent if the pressure is less than that required to remove all the cellulose.

MAY 14, 1867.

Q. 65. Have you examined and tested the specimens, marked Nos. 1, 2, 3, 4, sealed by C. Jacobs and delivered to you by W. L. Shoemaker, in person?

A. I have examined them under the miscroscope and tested them.

Q. 66. Supposing that the said specimens were prepared as follows:
No. 1. By boiling shavings in caustic alkali;
No. 2. By treating No. 1 with chlorine;
No. 3. By treating No. 2 with alkali in forming the pulp;
No. 4. By bleaching No. 3;
State what was the condition of these respective specimens, and whether you consider the product and process of preparing them, as recited above, to be substantially the same or different from the invention of 1,448 and 1,449.

176 A. No. 1 is not disintegrated, it is full of intercellulose and blackens on the addition of acid. No. 2 is not disintegrated, it blackens with sulphuric acid. No. 3 is pure cellulose, and No. 4 is pure cellulose bleached. Unless the boiling in No. 1 with alkali was at the temperature named in reissue 1,449, or unless No. 3 was boiled at the same temperature, the process was not substantially the same as that set forth in reissue 1,449. I do not think that No. 1 had been boiled under pressure indicated in reissue 1,449, as its structure was so little altered.

Q. 67. Does the process of boiling wood in caustic alkali, as pursued at defendants' works, and as understood by you, fall within the claim of the patent of M. A. C. Mellier, of May 26, 1857?

A. The claim of the Mellier patent refers to straw alone.

Q. 68. Do not Keen's boilers, of patent of September 13, 1859, and the boiler of Lemuel Wright, of March 27, 1847, agree in both being vertical cylindrical boilers, and both having discharge-valves or cocks at the bottom, and that in both, vegetable matters are digested with caustic alkali under pressure, and that the matter, after being digested in both, is discharged by steam-pressure through the lower cock?

A. Yes.

Q. 69. Do you find in the defendant's boiler any stirrers or their equivalent, such as described in the patent of Keen, of September 13, 1859?

A. I do not.

Q. 70. Is the arrangement of valve in defendants' boiler, and the mode of operating the same, substantially as that described in the patent of Keen's, of May 1859?

A. In Keen's patent of 1859, there is a vertical plug valve operated by a hand-wheel at the top of the boiler; in defendants', it is a slide valve operated by a hand-wheel at the side of the boiler. How near these may be considered identical is a question for an expert in mechanics.

Q. 72. Do you find in defendants' apparatus a combined arrangement of boiler, expansion chamber, stirrers, and discharge cock?

A. I have said there were no stirrers, and therefore I do not find the combination.

Q. 72. Please examine the report of Garrett, Muckle, and
177 Neall, as to the mode of treating straw, and as to the pressure at which the straw was boiled in the caustic alkali, at the defendant's mills, into pulp, of which H 4 was a sample, and state

whether said operation was substantially the same as the invention set forth in reissue 1,449, and whether said product was the same as that patented by reissue 1,448?

A. I cannot judge from the report as to the per cent. of alkali used, inasmuch as it was mixed with refuse liquor of a former operation, containing refuse besides alkali, and which was a higher specific gravity than the original solution of caustic alkali. The temperatures, during one-half of the operation, were below 290° Fahrenheit, (estimated;) during the remainder of the period, they were between 290° and 300° Fahrenheit, (estimated,) and the latter part of the operation reached about 304° Fahrenheit, (estimated.) In so far as the temperature approached or exceeded 300°, it was the same as reissue 1,449. The product as examined by me was, as heretofore stated, not completely pulped. In my opinion, the reissued patent 1,448 calls for a completely pulped product by the action of alkali and heat alone, and to this extent it differs from said reissue.

Q. 73. What force do you give to the word "near," used in connection with 300°, in reissue 1,449?

A. I should say about 295°.

Q. 74. Have you any special reason, based on chemical actions, for fixing that limit to word "near?"

A. I have not; it is a mere opinion.

Q. 75. Please state whether the preparation of pulp, like Exhibit H 4, as described by Professors Garrett and Muckle, and Neall, at defendants' works, substantially the same as the invention described and claimed in the patent of M. A. C. Mellier, of May 20, 1857.

A. The temperature does not reach those claimed in the patent of M. A. C. Mellier, viz., 310° Farenheit.

Q. 76 In the patent of M. C. Mellier, dated May 26th, 1857: 1st, is it not specifically stated that the boiling is to be regulated by a pressure gauge? 2d, that the pressure should be maintained in the inside of the boiler of from 70 to 84 pounds? 3d, that the proper quantity of alkali to be used is 70 gallons of a solution of
178 caustic alkali of 1.013 to 1.020 specific gravity to each cwt. of straw? 4th, that this heat and pressure should be kept up for about three hours? and are not these important instructions to enable a paper-maker to carry out practically the process without experiment?

A. It is so stated. These instructions are important to enable a paper-maker to carry out the invention without experiment?

Q. 77. You have stated that woods of average condition require about twenty pounds of caustic alkali to the 100 pounds of wood, and that a pressure of about 160 pounds gives the required temperature to insure good pulp, and that about five hours is required to complete the process, as the invention is carried out practically at plaintiffs' works at present. Please point out to me, in the specification of reissue 1,449, how a paper-maker reading the same, without further experiment on his part, could arrive at any knowledge of the quantity of alkali to use, and the pressure to be employed at the time of the operation, so as to produce such pulp as you have des-

cribed in your 12th answer, from any wood or vegetable substance whatever.

A. The specification does not give the proportionate quantity of alkali. A paper maker could not ascertain the facts, referred to in the question, from the specification without experiment. The specification expressly states that the strength of alkali, the temperature, and the time must vary with the material under treatment.

Q. 78. What experiment would a paper-maker be required to make in order to ascertain what quantity of alkali to use, say with deal or with poplar wood?

A. He would weigh a quantity of wood, a measured quantity of solution of alkali of known strength, say 12° Beaumé, and digest the same at a pressure of say 150 pounds, for an observed time, say two hours, then open and take out specimens and examine them; if pulping had not been completely accomplished, he could test the caustic alkali, and if still caustic, he would be satisfied that the effect was not in having used too small a quantity of alkali. A second trial, at a higher temperature and prolonged time, would probably
179 yield the desired result. No mere direction, verbal or written, will enable a man successfully to carry out chemical manufacturing operations without some experience.

Q. 79. Suppose wood to be pulped by boiling in caustic alkali first, and then treated with chlorine to complete the operation, would there be any substantial difference whether the first boiling took place at a pressure due to a temperature of 300°, or at a pressure due to a temperature of 280° Fah.? If so, what is that substantial difference in the chemical operation?

A. As the temperature is reduced the action of the alkali is diminished, and this diminished action would require a proportionate increase of the action of the chlorine or its compounds to complete the result.

Q. 80. Suppose wood be pulped by boiling in caustic alkali first, and then treated with chlorine to complete the operation, would there be any substantial difference whether the first boiling took place at a pressure due to a temperature of 280° or at a pressure due to a temperature of 260° Fah.?

A. I would make the same answer as to the last.

Q. 81. Would this same rule hold good up to 360° Fah., or that point of temperature, whatever it may be, where boiling in caustic alkali alone would remove all the intercellulose and make pure pulp?

A. I believe so.

Q. 82. So far as your knowledge or experiments have gone, you could not find any lower point than 360° as the one at which chlorine could be entirely dispensed with as a pulping agent with wood?

A. No, I could not; but my experiments were limited in number. I believe there is a point below that with some woods, because different vegetable matters vary in their resistence to chemical agents.

B. HOWARD RAND.

Sworn and subscribed before me this fourteenth day of May, A. D. 1867.

CHARLES SERGEANT, *U. S. Commissioner.*

180 In the Circuit Court of the United States for the eastern district of Pennsylvania.

Complainant's evidence.

THE AMERICAN WOOD PAPER COMPANY
vs.
JACOB D. HEFT ET AL.

Depositions of witnesses produced, sworn, and examined on the part of the complainants in the above case, before Charles Sergeant, United States Commissioner, at his office, No. 123 South Fifth street, Philadelphia, commencing on the 13th day of October, 1866, and continuing from day to day, as adjourned, and adjournments noted.

Present: Thomas A. Jenckes and Henry E. Wallace, esqs., for complainants; George Harding, esq., for defendants.

Hugh Burgess, being duly sworn on behalf of complainants, doth depose and say, as follows:

Q. 1. What is your name, age, residence, and occupation?

181 A. Hugh Burgess. I am forty years old. I reside at Royer's Ford, Montgomery county, Pennsylvania; I am a chemist.

Q. 2. Are you the person named in the patent granted to Charles Watt and Hugh Burgess, in England, dated August 19, 1853, and in the United States, dated July 19, 1854?

A. Yes, I am.

Q. 3. State when the invention described in the specifications attached to said patent was made, and under what circumstances.

A. I commenced to make experiments on the preparation of pulp for paper making purposes in the year 1851, in conjunction with Mr. Charles Watt. On account of his great age, most of the experiments devolved on myself.

Q. 4. Describe the first experiments made to carry the invention into effect, and their results.

A. My first experiments were carried out on a small scale. At this time I had no laboratory of my own, and was limited as to apparatus, and was obliged to work with such apparatus as I could find in my friends' laboratories. Such apparatus as I could not procure in one place I would seek in another. The vessels used for boiling wood in alkali, under pressure and without, were of the ordinary kinds used in a laboratory, such as small iron boilers, glass flasks, and iron enamelled ware. I generated the chlorine and hypochlorous acid in the usual apparatus, making large glass vessels answer the purpose of gasing and bleaching chambers. I worked until I ascertained the nature of the intercellular tissue of wood, what means would effect its destruction and leave the fibre intact, and also what was the proportion of this fibre. The decomposition of the intercellular tissue was effected by several methods. Sulphurous, chromic, and permanganic acids were used, and pulp was produced. The The effect of caustic alkaline solutions was examined into, as well as

chlorine, in a liquid and gaseous form. I made a great many experiments in boiling wood in caustic alkaline solutions. My knowledge of chemical reactions taught me the great advantage afforded by increase of temperature in effecting chemical decompositions, and the idea of boiling under pressure occurred to me. I produced a good pulp by boiling wood in caustic alkali, at a high tem-
182 perature. I found that some woods required much more alkali than others. I found that when the intercellular tissue could not be wholly removed by caustic alkali, it could be decomposed by chlorine—all the hypochlorites, one answering the purpose as well as the other. I used therefore, chlorine, or bleach powder—preferably chlorine—as one of the products attending the elimination of chlorine, viz : sulphate of soda, had a marketable value in England.

I found that, to a certain extent, I could substitute the employment of caustic alkali for chlorine, the one for the other, but the nature of the wood under treatment materially affected this substitution. I found that the greater the quantity of intercellular tissue was removed by caustic alkali, the less chlorine or its equivalent was required. I mean, by its equivalent, hypochlorus acid. And consequently the higher the temperature under pressure, and the greater the strength of the alkali employed, the less of the intercellular tissue was left, and consequently less chlorine or its equivalent was required. But if sufficient caustic alkali was employed at a requisite temperature, only sufficient chlorine was necessary for bleaching purposes; as regards the cost, the chlorine process appeared to cost less than the free use of alkali, since one of the products of its elimination is a marketable article in England, and we calculated on the sale of the sulphate of soda as one of the sources of profit in working the patent. In drawing up the specifications for a patent, I therefore laid most stress on the process that seemed to offer the greatest pecuniary advantage, since the recovery of the soda-ash had not been practically tried by us at this time, and we were in uncertainty as to the success of such recovery. With a knowledge of the above facts, I was desirous of embracing in my specifications the modes of producing wood pulp either with or without steam pressure, supplementing, when necessary, the alkaline boiling by the subsequent treatment of chlorine or hypochlorite. In my rough draft of specifications drawn up in 1852, I described the use of boiling either under high or low pressures in the following words : "The shavings should then be boiled in caustic alkali of the strength indicated by about 12 of the English hydrometer. This process is much better performed under high pressure after the wood has
183 been boiled for about twenty-four hours; but we do not confine ourselves to this time, as it varies with the nature of the wood and amount of pressure." I used the words, "and amount of pressure," purposely to express that I did not confine myself to any definite amount of pressure, as I was aware that I could increase the chemical effect of the alkaline solution in its action on wood by increasing the temperature, or, in other words, the pressure.

(Mr. Harding objects to the foregoing answer.)

Q. 5. Who prepared the specification of the English patent?

A. I prepared the specification; both provisional and final.

Q. 6. State whether you prepared a description of your invention prior to your application for a patent; and if so, and the same is in your possession, produce it, and annex a copy to your deposition, and state whether or not it is the paper referred to in your answer to the fourth interrogatory, and whether the remarks made in your answer to that interrogatory are applicable to this draft.

A. I prepared a rough draft of the specification previous to my application for a patent. I have the same in my possession. This was prepared previous to the specification of the English patent of 1853. This is the rough draft I now produce. (Paper marked and identified by commissioner.) This paper which I now produce is a photographic copy of that part of the original rough draft above mentioned, which refers to boiling at a high temperature. (Paper marked Exhibit H. B. 1, C. S.)

(Mr. Harding requests the commissioner to annex to the deposition a copy of the original paper, and that the original be marked as an exhibit, and produced at the hearing.)

This is the same paper referred to in my answer to the fourth interrogatory, and my remarks made in my answer to that interrogatory are applicable to this rough draft, and refer to it.

(This answer objected to by Mr. Harding.)

Q. 7. State whether any portion of this description was modified in the specification attached to the patent, and why.

A. After preparing the rough draft of specification, I was impressed with the idea that I should invalidate our patent if I
184 broadly claimed pressure-boiling as part of my invention, as I was aware that boiling under pressure, as a process, was not new. I had also ascertained that a patent existed for boiling rope and rags under pressure, though at too low a temperature to pulp wood. In the specification finally decided on I disclaimed the process of pressure-boiling generally as my invention; but I believed I had so expressed myself as to claim as our process the boiling wood in caustic alkaline solution, both under or without pressure, the amount of pressure being determined by the subsequent chemical treatment of the boiled wood or pulp, as the nature of the wood should determine. At this time I was not aware that any previous attempt had been made to produce a pulp from wood, and was ignorant that any previous process for pulping wood by boiling in alkaline solutions under pressure existed. I added the preliminary sulphurous acid process, which appeared to offer some advantages.

(Objected to by Mr. Harding.)

Q. 8. State whether or not you were governed by the reasons stated in answer to the last interrogatory in preparing your specification, as annexed to the letters patent granted in the United States.

(Question 8th objected to by Mr. Harding.)

A. In preparing the American specification I had no reason to alter the general wording of the specification of the English patent, as I believed it covered all the practical modes of making wood pulp

that I was acquainted with, and I was not aware that sulphate of soda was of little or no value in this market, or that manganese, a production of chlorine, was so expensive.

(Answer to 8th objected to by Mr. Harding.)

Q. 9. State when you came to this country, and for what purpose.

A. Soon after the English patent was granted the proposition was made to me by Mr. F. B. Houghton to work the patent in the United States. On the preliminaries being arranged, I left England for that purpose and arrived in New York in the beginning of February, 1854. As soon as I could learn that there was a probability of my obtaining the Watt and Burgess patent in this country, in conjunction with Mr. M. L. Keen, I proceeded to look for a site on which to put up small works, and to order the necessary apparatus.
185 I designated what apparatus would be necessary, viz: the vats, &c., in which to make caustic alkali, and a boiler capable of sustaining considerable pressure for boiling the wood in caustic alkali, as well as the gasing and bleaching chambers. We rented an old locomotive shop at Gray's Ferry, belonging to the Philadelphia and Baltimore Railroad Company, and put up our apparatus in this place.

(Answer to 9th objected to by Mr. Harding.)

Q. 10. State what you did about procuring the necessary apparatus for working your invention, and what was ordered by you for that purpose.

A. The apparatus was procured as stated in the preceding answer.

Q. 11. Was this before or after your application for a patent in this country?

A. The apparatus referred to in the answer to the preceding interrogatory was ordered after the application for the United States patent, but previous to its being granted. We had most of the apparatus in place at the time of the issuing of the patent. The pressure boiler was, I believe, ordered in June, 1854.

Q. 12. State when the apparatus was first put in operation.

A. In August, 1854, about the middle of the month.

Q. 13. State whether you then used caustic alkali, under pressure, created by heat, for the purpose of producing pulp from wood?

(Objected to by Mr. Harding.)

A. We boiled wood in caustic alkali, under high pressure and temperature, and produced wood pulp by this means in the summer of 1854.

Q. 14. Did you make any memoranda at the time of the mode of working your process? If so, state how and when and within what period they were made, and for what purpose.

(Objected to by Mr. Harding.)

A. I kept a journal of the results of our working at Gray's Ferry. The first entry was made August 20, 1854. I kept this journal for about five months, till we ceased operations at Gray's Ferry. I kept it for the purpose of noting the quantities of materials used, the results of the process, and the quality of the pulp produced.

186 Q. 15. Produce such memoranda, and annex copies of the same to your deposition, with such explanations as will make them intelligible.

(Objected to by Mr. Harding.)

A. I here produce my original journal, and also photographic copies of such parts of it as relate to the manufacture of pulp from wood.

(Original Journal, marked H. B. 2, C. S.; copies marked H. B., 3 to 13 inclusive.)

On number 3, experiment "f," the entry, one pound of sawdust boiled to a pulp, &c., was made, in order to prove the loss that would accrue to such pulp by bleaching. This loss, arising from the handling and the bleaching, was 9.40 per cent., which proves that in August, 1854, we produced a nearly pure pulp by boiling in caustic alkali, under pressure. On Exhibit 4, the entry (C) proves that by boiling wood in caustic alkali, under pressure, we obtain 34 per cent. of pulp. This yield is a proof of the purity of the pulp so obtained, as ordinary wood only contains from 30.38 per cent. of pure cellulose or fibre. On Exhibit 4 are some small experiments relative to the recovery of soda-ash. Exhibit 5 refers to the production of a fair pulp by boiling wood in caustic alkali. Exhibit 6 refers to wood softened, but not pulped from the uncausticized state of the alkali. I would here remark that our apparatus for making caustic alkali was very inferior, being only made of wood. Exhibit 7 refers to a boiling failing from want of steam pressure, the pipe having burst. Exhibit 8 refers to a fact that the wood was not pulped by an experimental boiling soda-ash and lime mixed in the boiler together. Exhibit 9 demonstrates that when we failed to produce pulp by means of boiling, under pressure, in alkali, we were accustomed to reboil with fresh alkali, if necessary, till the pulping was produced. This exhibit also refers to our mode of blowing out our boiler while under pressure. Exhibit 10 again demonstrates our customary method of reboiling when the wood was not sufficiently pulped.

Exhibit 11 proves the production of a good pulp by boiling wood in caustic alkali, under pressure.

Exhibit 12 demonstrates our mode of reboiling, till pulping was obtained by boiling caustic alkali.

187 Exhibit 13 demonstrates that the wood was not pulped, owing to the alkali being neutralized in that experiment.

(Mr. Harding objects to the answer to the 15th interrogatory.)

Q. 16. State whether you succeeded in the manufacture of paper pulp from wood, and what was done with the pulp so made.

(Question objected to by Mr. Harding.)

A. The manufacture of pulp from wood, by the processes as recorded in my journal, was a success. Some of the pulp, made at Gray's Ferry, was sent to Mr. Warren's paper mill, Mahlonville; some to Messrs. Magarge Brothers, and some to Mr. Howard Lewis.

Q. 17. State where the manufacture has been carried on since 1854, and to what extent.

(Objected to.)

A. After the manufacture at Gray's Ferry was considered a success, larger works were put up at Royer's Ford; the capacity of these works being from two to three tons a day. These works are still in operation, and now being increased to five or six tons a day. We moved to Royer's Ford in 1855, and commenced work in 1856. In 1866 works were put in operation at Manayunk capable of turning out about twelve tons a day.

Q. 18. State whether the process used has been substantially the same throughout.

A. The process for the manufacture of pulp from wood now carried on is substantially the same as that used at Gray's Ferry, by the Watt and Burgess patent, when first operated. We use the hypochlorites, or bleach powder, in place of chlorine. The recovery of soda-ash has been improved on, enabling us to use a larger quantity of this material for every day purposes, and, consequently allowing us to dispense with the use of a certain proportion of chlorine or bleach powder. At the present time we occasionally use the double process, as described in the Watt and Burgess patent, when we are working on old, highly resinous woods; that is to say, that, after the wood has been boiled to a pulp, by means of caustic alkali, at a high temperature, it is treated by hypochlorites in solution; again treated with alkali, and bleached.

188 Q. 19. State the length of time required for pulping a boiler filled with wood, as the manufacture has been hitherto carried on at Royer's Ford.

(Objected to.)

A. The boiler is filled and discharged, on an average, in four hours.

Q. 20. State when you began to discharge the contents of the boiler, under and by means of pressare.

(Objected to.)

A. In the winter 1854, '55, I believe, December, 1854. By reference to Exhibit 5, I fix December, 1854.

Q. 21. State whether or not all that is shown in the Exhibits from 3 to 13 was written in your journal at the times when the entries purport to have been made, and if any marks or lines were made subsequently, state what they are and when made.

A. The entries were all made on the days of the experiments. The pencil underscoring was made at the time my books and papers were submitted to Mr. Jenckes, previous to the formation of the American Wood Paper Company.

OCTOBER 15, 1866.

Present—Counsel for respective parties.

Cross-examined.

By Mr. Harding:

Q. 1. When and where did you study chemistry?

A. In Edinboro', Scotland, with Professor Johnson the chemist of the Highland Society and author of the work on chemistry. In the year 1844, winter of 1844, and summer of 1845.

Q. 2. How were you engaged from that time till 1852?

A. Till the year 1850 I was engaged in the manufacture of chemical, the rare chemicals, mostly the alkaloids, and the more valuable chemical salts. From 1850 till the time I left for this country, I was engaged in scientific investigations of various characters. I was mainly engaged in the year 1850 and 1851, on electric experiments and on the examination of vegetable substances, and was partly engaged in making survey for one of the London Water Works. In 1852 I was
189 mainly engaged in investigation of the pulping of vegetable substances, and on a process for coppering iron, and the same holds good as to 1853, and continued until I left for this country.

Q. 3. During your experiments in England how many different processes and how many solvents did you try for the obtaining of cellulose from wood?

A. To the best of my belief, four solvents.

Q. 4. State what these four solvents were, and what success you had with each.

A. Chromic acid, manganic acid, caustic alkali, chlorine and its compounds with oxygen. As far as regards the first two modes or solvents adopted their cost precluded their use, and besides, the results were not perfectly satisfactory. In regard to the use of caustic alkali, I found that if I used it alone its cost would appear to preclude its use with chlorine and the compounds of chlorine with oxygen. I found there were only very few vegetable substances that would attack and destroy the intercellular tissue without the previous use of caustic alkaline solutions. I found that by combining the use of caustic alkaline solutions at a proper temperature with the subsequent action of chlorine I obtained a process that appeared to give satisfactory pecuniary results.

Q. 5. At what date did you ascertain that by continuing chlorine and caustic alkaline solutions in successive action on wood you obtained a satisfactory result in prodoucing pulp?

A. I was engaged in these experiments for nearly three years. I believe that I perfected my process as early as 1851 '2; the winter of 1851 and 1852. I was subsequently engaged in endeavoring to improve upon the modes of obtaining chlorine and caustic soda by electric agency and other means.

Q. 6. When did you devise the process of obtaining pulp by submitting wood first to boiling for some hours in water; second, to the passage of a stream of sulphurous acid through the mass, till a partial bleaching was effected; third, submitting the material to chlorine or its compounds with oxygen, keeping the matters in solution till quite white and the fibres are disintegrated; and lastly, to heat the fibrous matter in warm water and a dilute solution of caustic potash
190 or soda, as stated by you in the provisional specification of August 19th, 1853, left by Charles Watt and Hugh Burgess at the office of the Commissioner of Patents in England?

A. I devised that process in the end of 1852. That was one of the many processes investigated by me.

Q. 7. How many processes do you suppose you investigated in like manner?

A. I cannot say. I used nearly every chemical mode I could think of likely to effect the object I had in view, viz., the destruction of the intercellular parts of plants without attacking the fibre.

Q. 8. Please give me the rationale of each stage of that process mentioned in question 6.

A. I cannot give the effect of each individual chemical action; but the effect of sulphurous acid and chlorine would be to alternately deoxidize and oxidize various portions of the intercellular tissue, which would be thus rendered soluble in the solution of caustic potash or soda, having previously removed the acids formed by the action of the chlorine by means of the warm water.

Q. 9. In that process how warm was the water required to be to make the process successful? And what do you mean by warm water, as used in that provisional specification?

A. In this case, warm water need only have been lukewarm, as it was only for the purpose of removing the acids produced by chlorine,

Q. 10. What was the disintegrating or pulping agent in that case?

A. The pulping was effected by the destruction of intercellular tissue by the agency of the sulphurous acid and the chlorine, and the removal of the oxidized intercellular matter by the means of the dilute solution of the caustic soda.

Q. 11. Did you ever try sulphurous acid without chlorine?

A. Yes; on certain vegetable substances.

Q. 12. What was the result?

A. It was only satisfactory in one or two materials, when used by itself; I can't remember those now. All my answers, in reference to my experiments, are given from a recollection of twelve years; I have not looked at a note-book since then.

191 Q. 13. What became of the process mentioned in question 6?

A. It was given up, like many others, as materials used seemed to cost too much.

Q. 14. What part did Charles Watt take in the discovery of that process mentioned in question 6?

A. I believe that in this process we worked more or less together.

Q. 15. What remark did you make as to the part you took in other processes?

A. In the processes requiring much mechanical apparatus I worked mostly alone, and would, if I thought desirable, report the results of my experiments.

Q. 16. When did you devise the process of making pulp by the use of chloride of sodium, decomposed by electric agency?

A. I was engaged on that experiment of making caustic soda, for the purpose of using it, from the end of 1851 to 1853.

Q. 17. What was the result of the attempt to employ the chloride of sodium, decomposed by electric agency?

A. The caustic soda and the chlorine, as so produced, were considered as too costly, or, at any rate, of hardly sufficient value as to make the process useful.

Q. 18. How long after you described that process, in the provisional specification, filed August 19, 1853, was it that you abandoned the attempt to employ chloride of sodium, decomposed by electric agency?

A. I have not abandoned it up to the present time.

Q. 19. Why did you omit from the specification of your American patent the process of submitting wood to boiling some hours in water, then to a stream of sulphurous acid, then to a solution of chlorine or the oxide of chlorine, until the matters were quite white and the fibres disintegrated?

A. Because I believe the process described in the American patent contained all that was necessary that was embraced in the English patent?

Q. 20. With whom did you consult in preparing your English specification?

A. That I can't remember.

Q. 21. Had you an attorney?

192 A. Pool and Carpmael took out my patent, but at the time I had not the means to consult them as attorneys.

Q. 22. Have you ever put in practice the process of using boiling-hot water, treating with sulphurous acid, and then with chlorine, until the fibres were white and disintegrated, and then with a dilute solution of soda or potash in warm water, as a means of making pulp?

A. Only on a small scale.

Q. 23. When and where?

A. I believe at the labratory of Mr. N. K. Collins, Cannon street, London; I think in the summer of 1853; I am not sure.

Q. 24. What was your object at that time in trying it there?

A. If I remember right, it was to get at the cost and quantity of material.

Q. 25. Was this with a view to put it in practice?

A. I believe it was.

Q. 26. Did you ever employ chloride of sodium, decomposed by electric agency, on a practical scale, in connection with the manufacture of paper pulp?

A. I made caustic soda and chloride from chloride of sodium, on a practical scale, but cannot state whether I used the identical caustic soda and chlorine so prepared in the manufacture of paper, as I should obtain no object in so doing.

Q. 27. In your specification of August 19th, 1853, you state that your invention has for its object better means than those at present practised for disintegrating and pulping vegetable substances, for the manufacture of paper, &c., &c. What means then practised did you then refer to?

A. At that time I was only aware of the mode of boiling straw in lime.

Q. 28. Where was that practised?

A. I only know that it had been done.

Q. 29. On what wood did you experiment in England, prior to filing your final specification of February 18th, 1854?

A. I experimented on several woods, more particularly on the resinous woods, as pine and fir.

Q. 30. Can you name any other woods?

193 A. Beech and willow; perhaps others, but I cannot remember them now.

Q. 31. What do you mean by the names deal and fir in your specifications?

A. They are both known in this country as pine.

Q. 32. What is the effect of boiling deal or fir wood in a solution of alkali, of about 12° of the English hydrometer, not under pressure?

A. Its effect would be only to remove certain of the resinous oils, and perhaps a very slight portion of the intercellular tissue.

Q. 33. What would be the appearance of this kind of wood, so treated?

A. When dry, they would be more or less of a yellow color, darker or lighter, according to the strength of the alkali used; if very long boiling was made use of, they might be partially disintegrated.

Q. 34. What would be the effect of boiling it for twelve hours, in an open vessel, in caustic alkali of 12° of the English hydrometer?

A. If the shavings were packed in the boiler closely, their form would not be much altered, though they might be more or less separated with the grain by the fingers, or with only a slight mechanical action.

Q. 35. Would the intercellular matter be removed to any practical extent?

A. But little of the true intercellular matter would be removed. The loss of weight would mostly arise from the removal of the resinous oils.

Q. 36. What would be the effect of boiling shavings of willow, under like circumstances?

A. I think more of the intercellular tissue would be removed than in the case of pine wood; but I have never been able to effect the true pulping of willow by this means, that is, by boiling in caustic alkali, without pressure.

Q. 37. After the shavings of deal or pine had been boiled in caustic alkali of the above strength, 12° English hydrometer, what would be the effect of placing damp shavings on racks and submitting them to the action of the chlorine, or its compounds with oxygen?

194 A. The effect of the chlorine, or its compounds, with oxygen, would be to oxidize most of the intercellular tissue, and convert it into a substance soluble in alkali. I believe that substance to be either humic or ulmic acid.

Q. 38. What would be the effect of submitting shavings of willow, which had been boiled in caustic alkali not under pressure, to the action of chlorine and its compounds with oxygen, in like manner?

A. Its effect on chlorine would be the same as with pine.

Q. 39. Would the mass, in either of the cases, be pulped after the chlorine treatment?

A. They would be very tender to the touch, but would not be a pulp.

Q. 40. Would the intercellular matter still be in its place?

A. It would, but in a changed form.

Q. 41. What would be the effect of submitting to a weak solution of caustic alkali the pine or willow shavings, after the chlorine treatment as above, and what would be the product?

A. Its action would be to remove by solution the changed intercellular tissue, and ulmate of soda or potash is formed; nearly pure pulp is left as a residuum.

Q. 42. What would be the effect on the whole process if, as inquired about, of boiling in alkali at 12°, (English,) treating with chlorine, and then again with caustic alkali, if the caustic alkali, in the first stage of the process, was kept boiling under a pressure of fifteen pounds?

A. Some little more of the intercellular tissue would be removed by the increased temperature, and the chlorine, in consequence, would be required to complete the nearly entire removal of the intercellular matter.

Q. 43. What effect in the length of the process would such increase of temperature have, and which, if either of the three stages of the process, could be well omitted?

A. In boiling wood at the strength of alkali and pressure named in the question, the time necessary for the boiling would no doubt be diminished; but I do not think that at the above pressure any of the above-named stages of process could be well omitted.

195 Q. 44. Suppose the pressure were increased to 30 pounds, which, if either, of the stages of process could be omitted?

A. If a sufficient quantity of alkali was used, at a pressure of thirty pounds, the chlorining action and subsequent alkaline treatment might, perhaps, be dispensed with, as a rough pulp, but not pure fibre, would be produced.

Q. 45. Supposing the object of this process to be the manufacture of such a pulp as you aimed at and accomplished by your combined process of being in alkali, chlorining and reboiling in alkali, could either of these processes be omitted, if a pressure of thirty pounds was used with the first boiling in an alkaline solution of twelve degrees (English hydrometer)?

A. In resinous wood, certainly not; in non-resinous woods, I do not think they could, as I have not made an experiment in non-resinous woods at so low a pressure.

Q. 46. Were the experiments you made in England, prior to August 14, 1853, on resinous or non-resinous woods?

A. My experiments were made both on resinous and non-resinous woods; but I found I should have to look to resinous woods only for my supply of material.

Q. 47. What would be the effect, if the pressure were to be increased to forty pounds, the other conditions remaining as in question 45?

A. I am unable to answer that question, as I don't know exactly the temperature at which the same effects would be produced by caustic alkali equivalent to the combined effects of chlorine and its subsequent alkaline treatment were it superadded.

Q. 48. What would be the effect of increasing the pressure to fifty pounds, the other conditions remaining the same as in question 45?

A. At fifty pounds, non-resinous woods would be roughly pulped; but the resulting pulp would not be pure fibre. With resinous woods, but a very slight pulping would be effected in all probability.

Q. 49. When did you ascertain the truth of the fact contained in your last answer as to resinous woods, and when as to non-resinous woods?

A. In 1852 I produced a pulp by boiling in caustic alkaline
196 solution both from resinous and non-resinous woods, and produced thereby pure pulp; but I had not the means at my disposal for determining the pressure I used. I did not fix as to the amount of pressure necessary to be used for resinous or non-resinous woods until 1855, which was the first opportunity I had for trying non-resinous woods with the exact means of determining pressure, as I only used resinous woods at Gray's ferry.

Q. 50. Question repeated. I wish the witness to state when he ascertained the effect of treating wood with caustic alkali under a pressure of fifty pounds; first, as to resinous, and then as to non-resinous woods.

A. With resinous woods I ascertained the effect of fifty pounds pressure at Gray's ferry, in August and September, 1854; but with non-resinous woods, as I had not the non-resinous woods at Gray's ferry. I did not use them until 1856, at Royer's ford.

Q. 51. Question repeated. When did you ascertain for the first time what was the effect of treating non-resinous woods in caustic alkali, under a pressure of fifty pounds?

A. I did not know the exact pressures necessary for this purpose until I had exact means for reading the pressures, which was at Royer's ford, in 1856.

Q. 52. Question repeated.

A. In 1853.

Q. 53. How did you determine the effect produced by a pressure of fifty pounds, in 1853, on non-resinous woods.

A. I determined it by the character and purity of the pulp produced.

Q. 54. State precisely the experiment in 1853. Describe the apparatus used and what means you used for ascertaining that you were working at a pressure of fifty pounds at the time.

A. The apparatus I used was a wrought-iron mercury bottle. I had no means for determining pressures, except by the results.

Q. 55. Please explain to me how the results which you obtained enabled you to know at the time that you were working under fifty pounds pressure?

A. At the time I did not know the amount of pressure,
197 whether it was fifty pounds or over. I was accustomed to carry out my experiments as to quantity of alkali and amount of pressure only by the quality of the pulp.

Q. 56. Then in 1853, at the time you tried the experiment, you did not know what pressure you used?

A. I did not know the pressure I obtained, except by the desired result.

Q. 57. Did you or did you not know, in 1852, the number of pounds pressure per square inch to which the alkaline solution was subjected at the time you tried the experiment?

A. I did not.

Q. 58. When did you first try an experiment on non-resinous woods in which you did know the pressure to which the alkaline solution was subjected at the time of their treatment?

A. In 1852 I made comparative experiments between the boiling of resinous and non-resinous woods in caustic alkali, and I judged of the difference in the amount of required pressure by time alone, when exposed to the same sources of heat. I did not know the exact necessary difference of pressures that would effect the result until 1856, when I had the means of determining.

Adjourned to Tuesday, October 16th, 1866, at 11 o'clock a. m.

OCTOBER 16, 11 *o'clock a. m.*

Present: Messrs. Harding and Wallace, and the witness Mr. Burgess.

Q. 59. Please state when you made your first experiment by heating resinous woods in a close vessel with an alkaline solution until you obtained pulp?

A. In 1851.

Q. What was the wood? What was the size of the vessel? What was the quantity of wood used? How long did the process occupy, and who took part in the experiment with you?

A. The wood was pine. A mercury bottle, 14 by 6 or 8 inches, I think, was the vessel. I suppose about a pound of wood. I
198 cannot answer certain; I think, as far as I can remember, the first experimental process occupied about twenty minutes. I was alone; no one took part.

Q. 61. What was the strength of the alkali, and what was the pressure? and state what means you had of ascertaining the pressure.

A. I cannot remember, in this particular experiment, the strength of the solution. I do not know the pressure. I had no means of determining the pressure.

Q. 62. When did you try the next experiment with resinous wood? State the nature of the wood, the pressure you used, the means you, had for ascertaining the pressure, and the strength of the alkali. I mean the next experiment in which you obtained pulp, by boiling in alkaline solution, under pressure.

A. I cannot give the date of my next experiment. I don't think I used a hydrometer till, perhaps, the fourth experiment. I kept my alkaline solution in a carboy, and diluted it as I used it. To the best of my belief, I used from 18 to about 4 of the English hydrometer. As far as regards the wood and pressure, and quantity of alkali, I make the same answer as to question 61. I should think the second experiment was in 1851. I am sure that the first, second, third, and fourth experiments were in 1851.

Q. 63. Were all your experiments in making pulp, by the use of alkaline solution, tried in this mercury bottle?

A. No. I used a cyanide of potassium pot, but could not get my cover tight, and did not, consequently, obtain but little pressure.

Q. 64. When was it you used the cyanide of potassium pot?

A. In 1851.

Q. 65. Did you use any other instrument than a mercury bottle, and your unsuccessful experiment with cyanide of potassium pot, for boiling wood in alkali under pressure, prior to your experiments at Gray's ferry, in 1854?

A. No; only sealed glass tubes.

Q. 66. When did you try your experiments with sealed glass tubes? What pressure did you employ in those tubes, and how did you measure it?

199 A. I must have used the tubes in the early part of 1853. I do not know the pressure employed; I had no means of ascertaining it.

Q. 67. When did you first try an experiment on resinous woods boiled in alkali, under pressure, until it became pulp, having the means of ascertaining the pressure at the time, and what were those means?

A. At Gray's Ferry, in 1854. The means used was the safety-valve, which was set at 120 pounds—Mr. Crawford, former foreman of the shop, telling us that it was not safe to take the boiler belonging to the Philadelphia and Baltimore Railroad Company beyond that pressure; and we were generally accustomed to boil with the valve blown off.

Q. 68. What was the lowest pressure at which you boiled resinous wood, at Gray's Ferry, in a solution of caustic alkali, until it became a pulp?

A. We boiled at various pressures at different times. I do not remember the lowest pressure we used at Gray's Ferry.

Q. 69. When did you first ascertain the minimum pressure at which resinous wood could be converted into pulp by boiling in caustic alkali, under pressure, and what means had you for measuring the pressure at the time?

A. We first ascertained the precise minimum pressure at which resinous wood could be boiled at Royer's Ford, April, 1856; not having precise means for determining pressures previous to that time I used the spring steam-gauge.

Q. 70. What did you then ascertain to be the minimum pressure at which resinous wood could be converted into pulp by boiling in alkali under pressure?

A. At a temperature of the solution equivalent to about fifty-five pounds, if the solution was about 17 to 18 English hydrometer.

Q. 71. What was the lowest pressure at which you had knowingly converted resinous wood into pulp by boiling in alkali under pressure, prior to that time, and what were the means which you employed of ascertaining the minimum pressure at the time?

A. That question I cannot answer, as I had no exact means

200 of determining the pressures previous to that time, April, 1856.

Q. 72. Did you knowingly succeed in converting resinous woods into pulp at a pressure less than about 120 pounds at Gray's Ferry, and, if less than that, how much less?

A. I cannot answer that question.

Q. 73. Why?

A. Because I have no notes of the amount of pressures we used, and my memory does not serve me.

Q. 74. Did you ever attach to the boiler at Gray's Ferry a gauge for the purpose of ascertaining pressures at which you worked or could succeed in pulping resinous woods by boiling in caustic alkali under pressure?

A. I never did.

Q. 75. What was your object in ascertaining this pressure at Royer's Ford? Why did you attach the gauge then and test the minimum pressure at which resinous wood could be pulped by boiling in alkaline solution under pressure?

A. In putting up the boilers at Royer's Ford gauges were attached as part of the necessary apparatus; in the course of working these boilers the exact amount of pressure necessary to pulp the resinous woods was ascertained:

Q. 76. Was it by accident or design that a batch of resinous wood was cooked at a pressure of 55 pounds, until it was pulped, in those boilers at Royer's Ford; I mean on the first occasion, when it was so done as testified by you in answers 69 and 70?

A. I cannot precisely answer that question.

Q. 77. Why not?

A. Because I do not think I have any entries in my note-book for April, 1856, which would cause me to remember the details of each boiling?

Q. 78. You have remembered very distinctly the strength of the alkali solution at 17 English hydrometer, and the month of April, 1856, and the temperature as one equivalent to a pressure of 55 pounds. How did you measure the temperature, what led you to measure it at the time, and how do you remember all these other details of your working without your notes?

A. In question 69 you ask me when did you first ascertain
201 the minimum pressure at which resinous wood could be converted into pulp by boiling in alkaline solution under pressure, and what means had you for measuring the pressure at the time. I answer it was in April, 1856, because it was the first time I had the means for precisely ascertaining pressures at which we boiled. Not having such means before I could not determine what this pressure might be, and therefore made a general answer as to the amount of pressure necessary to pulp resinous wood. I measured the temperature subsequently; I did not measure it at the time. I can remember details because we used caustic alkaline solution from 12 to 17 English, and the month as April, 1856, as it was the first time we started works at Royer's Ford.

Q. 79. Did you start with boiling resinous wood at Royer's Ford at 55 pounds pressure; and, if not, at what pressure did you start there?

A. We did not start boiling resinous woods at 55 pounds pressure; but, to the best of my belief, we used 175 pounds.

Q. 80. Was it by accident or by design that you first came to know, as a scientific fact, that at a minimum pressure of 55 pounds resinous woods could be practically boiled into pulp, and who tried the first experiment to ascertain the fact, so far as you know, by either a measurement of the pressure or thermometrical measure of the temperature?

A. It was by design that the minimum pressure of 55 pounds was ascertained would practically boil resinous woods into pulp. Mr. Keen and myself ascertained this fact by frequent observations. I cannot state which of us precisely ascertained this fact, but I believe myself. I can't answer precisely as to who tried the first experiment to ascertain the minimum pressure at which resinous woods could be pulped, but believe it was myself.

Q. 81. How did you measure the temperature or pressure in that first experiment, if it was you who tried it?

A. Pressure would be measured by the steam-gauge, and the temperature of the solution would be calculated from the known facts that solutions are hotter according to their gravities and the temperature indicated by their pressure.

Q. 82. I do not ask how you would measure, but I ask you
202 how you did measure on the occasion of that first experiment?

A. If I was the one who ascertained the pressure I should have measured it by the steam-gauge.

Q. 83. Are you willing to swear that you ever did see a batch of resinous would cooked in caustic alkali into pulp at a pressure not exceeding 55 pounds; and, if aye, state when and where you yourself first saw this done.

A. I have seen resinous wood converted into rough pulp, with a large excess of caustic alkali, at a pressure not exceeding fifty-five pounds; but I have not seen a pure pulp produced by caustic alkali under a much higher pressure. This rough pulping that I allude to as being produced by large quantities of alkali at fifty-five pounds pressure was formed at Gray's Ferry, but I can only judge of the pressure used by performing a similar experiment and producing a similar pulp, in a small experimental boiler with gauge attached. I could not determine the pressure used at Gray's Ford except by this means.

Q. 84. At what minimum pressure are you willing to swear you have seen pulp, such as you contemplated making in your patent, made from resinous wood—I mean by boiling in caustic alkali, under pressure, alone?

A. Which patent do you refer to? Because there is more than one process described for the production of pulp, viz: either from resinous or non-resinous woods. And I wish to know whether the wood is to be treated by alkali alone or by subsequent treatment in chlorine?

Q. 85. Do you mean to say that the processes in the several patents which have been issued to Watt and Burgess differ so much in the processes therein set out, respectively, that you cannot answer my question without having one of these patents specifically pointed out?

(Mr. Wallace objects to the question as impertinent.)

A. No; I do not mean to say that the processes in the several patents differ so much in the processes set out therein that I cannot answer your question without having the patents specifically pointed out; but, as there are two processes mentioned, I wish to know to which process you alluded.

203 Q. 86. Then why did you not ask me which process I alluded to instead of which patent? If the patents are alike in the processes which they contain, why did you ask me which patent I meant?

A. I should have done so. It was an error on my part.

Q. 87. Please read question 84, and state whether it does not contain every condition to enable you to give me a precise answer? And if it wants any condition, state what that condition is.

A. No; your question does not contain every condition which is necessary to enable me to answer it, since there are two processes named in our patents, and you do not designate which you refer to when you ask me to state the minimum pressure which is necessary to make a pulp, contemplated in my patent, from resinous wood.

Q. 88. Do either of your patents contemplate making two distinct kinds of pulp from resinous wood? And if so, point out wherein the two pulps will differ?

A. No, they do not; but the amount of pressure would vary to a certain extent with the nature of the wood, and the quantity of chlorine which would therefore have to be subsequently used.

Adjourned till eleven o'clock, a. m., October 17, 1866.

OCTOBER 17TH, 1866, 11 *o'clock a. m.*

Present: Mr. Wallace, Mr. Harding, and the witness, Mr. Burgess.

Mr. Wallace states that Mr. Burgess is here in response to a subpœna from defendants, and not on the part of complainant.

Mr. Harding, in continuation of the cross-examination of yesterday, and in pursuance of the adjournment to 11 o'clock this morning, asks the witness, "When and where he performed the experiment, in the small experimental boiler, with guage attached, as mentioned by him, in answer to question 83?"

204 Mr. Burgess says: "Mr. Wallace shall I answer the question?"

Mr. Wallace replies to Mr. Burgess that he (Mr. Wallace) is in attendance before the commissioner, pursuant to an agreement of counsel, made last week with Mr. Rand, a witness for plaintiffs, to take the testimony of Mr. Rand, and is prepared to go on with the testimony of Mr. Rand, who is now present. He cannot, therefore, attend, as counsel to the cross-examination of Mr. Burgess, and pro-

tests against that cross-examination. The witness must be guided by his own judgment whether to go on and answer the questions in cross-examination; as, if he does so, he will have to do it without the presence of counsel.

By mutual agreement the further cross-examination of Mr. Burgess is adjourned to Thursday, the 18th of October, at 11 a. m.

OCTORER 18, 1866.

Present; Messrs. Jencks, Wallace, and Harding, and Mr. Burgess, the witness.

Q. 89. When and where did you perform the experiment in the "small experimental boiler, with guage attached," mentioned by you in your 83d answer?

A. At Royer's Ford, about May, 1856.

Q. 90. Did you then determine what was the minimum pressure at which resinous wood could be boiled in caustic alkali, so as to produce a pure pulp without further treatment?

A. I cannot say whether I determined, at the time mentioned in my last answer, as to whether I boiled resinous woods or not, but it might have been somewhere about that time.

Q. 91. If you did ascertain in said experimental boiler about that time what such minimum pressure was, state what you then found such minimum pressure to be. My question relates to the production of pure pulp, by boiling in caustic alkali, under pressure, without subsequent treatment.

205 A. To the best of my belief, I made these experiments to determine the relative quantities of caustic alkali required at different pressures, and to more or less determine what these relative ratios were, in order to confirm my previous knowledge on the subject. I found that, as I decreased my pressures, I had to increase the quantities of caustic alkali. To the best of my belief, I found that I could not reduce my pressures below 60 pounds, if I used a caustic alkali containing an absolute amount of soda equivalent to 48 per cent. of weight of dry pulp produced; that below 60 pounds, if I increased my percentage, of absolute soda, and increased the length of time, I could obtain nearly the same results, or, perhaps, the same results as I could with 60 pounds pressure; but I found that, to produce an absolutely pure pulp, I had to use for boiling, at a moderate length of time, in caustic alkali, containing an equivalent of soda equal to about 48 per cent. of pulp, a much higher pressure than 60 pounds.

Q. 92. Did you ever put resinous wood into that experimental boiler with a caustic alkaline solution, and obtain therefrom pure pulp at a pressure less than 60 pounds?

A. I never have obtained pure pulp from resinous woods, under pressure of 60 pounds, with a quantity of alkali, containing an equivalent of soda equal to 70 per cent. of the dry pulp obtained.

Q. 93. Did you ever put resinous wood into that experimental boiler with caustic alkaline solution, of any strength whatever, and obtain therefrom pure pulp, without subsequent treatment, under a pressure less than 60 pounds?

A. I have never tried a higher strength that I know of in that small boiler than the strength stated in my last answer, when boiling resinous woods, and I cannot therefore state what would be the effect of a higher degree of strength.

Q. 94. Question repeated. The witness is not asked for his opinion, but merely as to what he did.

A. I never obtained a pure pulp from resinous woods, at a pressure of sixty pounds, in the small experimental boiler.

Q. 95. Did you ever obtain pure pulp from resinous woods, at or below a pressure of sixty pounds, knowingly, in any boiler?

206 A. No; I have not.

Q. 96. What is the lowest pressure at which you have ever obtained pure pulp from resinous wood, by boiling in caustic alkaline solution, without further treatment?

A. I cannot answer that question unless the strength of alkali and the length of time employed for boiling, is given.

Q. 97. Do you mean to say that the length of time the material is to be boiled is essential to be set out, to enable any one to work the the process for making pure pulp from resinous wood?

A. No; the length of time cannot be set forth, as it depends upon various circumstances.

Q. 98. Question repeated.

A. The length of time dependent on the strength of the solution. I cannot answer the question as to the length of time necessary for me to determine the minimum pressure, unless the strength of solution is given.

Q. 99. Is it, or is it not, essential that the length of time the material is to be boiled be set out, in order to enable any one to work the process for making pure pulp from resinous wood?

A. Not if any definite amount of pressure to be used.

Q. 100. Then, if the pressure is left indefinite, and the length of time the boiling is to take place is left indefinite, could any person work the process for making pure pulp out of wood, by boiling in caustic alkali, under pressure, without further instruction?

A. Within certain limits, only, general instructions can be given, as both the length of time and the pressures must vary with the material used, that is the nature of the material.

Q. 101. Question repeated.

A. A person could work the process for making pure pulp from wood by following the instructions given in the patent; but the exact lengths of time, and the amount of pressure to be used cannot be defined.

Q. 102. Question repeated.

A. I cannot answer that question better than I have.

Q. 103. Were you asked any thing about the patent in my question?

A. No.

207 Q. 104. Why did you give an answer about the patent, if you were not asked about the patent in the question?

A. I referred to the patent because I thought you would be able

to understand my meaning better than you appear to do in my answers.

Q. 105. Do I understand you that you are unable to tell me, explicitly, whether a person could work the process for producing pure pulp by boiling wood in caustic alkali solution, without being informed both as to the pressure to be used and the length of time?

A. I wish to tell you explicitly that a person could work the process for producing pure pulp, by boiling wood in caustic alkali solution, without being informed as to the pressure and necessary length of time, if he was aware of the nature of the material he was about to operate on.

Q. 106. Please explain to me how the nature of the material would convey to his mind a knowledge of the length of time and pressure necessary in order to convert that material into pure pulp.

A. Because, in the description of the process, a distinction is made as to the various natures of the materials to be used, and the instructions given, as near as they possibly can be, show that the variation of length of time and pressure is necessary or advisable.

(Last answer objected to by Mr. Harding as not responsive.)

Q. 107. Suppose a party knew only that he desired to convert fir wood into pure pulp, by boiling in caustic alkali, under pressure, and was informed generally that boiling in caustic alkali, under pressure, would convert fir wood into pulp, could he make pure pulp without also being informed what pressure to use, and how long to use it?

A. He could not.

Q. 108. Suppose he were informed that fir wood could be converted into pure pulp by boiling in caustic alkaline solution, at a pressure of sixty pounds, could he work the process of making pure pulp out of fir wood, without being informed how long he was to boil it?

A. No, he could not.

Q. 109. What strength of alkali have you used in convert-
208 ing fir wood into pure pulp by boiling in caustic alkali, under pressure alone?

A. I can't answer that question, unless the amount of pressure is defined.

Q. 110. Suppose the pressure to be sixty pounds.

A. If the alkali contained an amount of soda equivalent to from seventy to eighty per cent. to the dry pulp, I could obtain nearly a pure pulp.

Q. 111. Did you ever so obtain it? My question asked as to your acts, not as to your opinions.

A. To the best of my belief, I did obtain a pure pulp, or nearly pure pulp, by the boiling in caustic alkaline solution, of the strength referred to in my last answer, in 1856, and at sixty pounds pressure.

Q. 112. My question relates to pure pulp; you answer as to nearly pure pulp. Did you ever obtain pure pulp under those circumstances?

A. The line of demarcation between a pure pulp and an impure

pulp is so small, that it is very difficult to define what a pure pulp really is.

Q. 113. Is there no way by which pure pulp and impure pulp can be distinguished—that is, what is the percentage of impurity in it?

A. There is a mode to distinguish pure pulp from impure pulp in a qualitative manner, but the quantitative determination of the impurity would be very difficult.

Q. 114. Then, if I understand you aright, the product of boiling wood in caustic alkali, under pressure, would vary as to the relative amount of pure pulp and impure pulp in the result produced, dependent upon the pressure used?

A. If the quantity of caustic alkali and the length of time were the same.

Q. 115. Suppose you were to use the quantity of alkali which you have specified, to wit, in the proportion of seventy to eighty per cent. to the dry pulp produced, what would be the relative amount of pure and impure pulp, in your judgment, at a pressure of fifty pounds?

A. I have not yet seen pulps of varying impurity produced from the same vessel, provided that the conditions as to alkali and heat
209 were the same in all parts of the vessel in which the boiling was made. I cannot, therefore, answer the question.

Q. 116. What kind of pulp did you contemplate making in your patent? What percentage of impure pulp would have rendered the result different from the one contemplated in your reissue No. 1,448?

A. Please state what you mean by the words, kind of pulp.

Q. 117. By the words, kind of pulp, to inquire whether the pulp produced was to be entirely pure or to contain a percentage only of pure pulp; and if a percentage only, what percentage of pure pulp.

A. The kind of pulp which we contemplated making by our patent was a pulp that should make a fair white paper. I cannot state what percentage of impure pulp would have rendered the result different from that contemplated in our reissue No. 1,448.

Q. 118. Now sir, having thus defined the nature of the pulp which you contemplated as one which would make fair white paper, please inform me what is the minimum pressure at which you have ever boiled resinous wood in caustic alkali, with a view to attempt to make fine white paper from the pulp, and failed to do so.

A. Is the pulp, referred to in your question, boiled in caustic alkali to be subsequently treated in chlorine, in the mode as described in the reissues 1,448 and 1,449?

Q. 119. Answer the question first. Supposing that the resinous wood is to be boiled in caustic alkali alone, without subsequent treatment, except ordinary bleaching; and also answer the question upon the hypothesis that the resinous wood is to be boiled in caustic alkali, and then gased in chlorine, and then boiled in caustic alkali again.

A. I cannot answer that question. It is impossible for me to remember the facts relating to my various boilings and experiments. I make the same answer to the latter end of the last interrogatory—to both branches of the same question, I mean.

Q. 120. What is the lowest pressure of which you have any recollection, at which you tried to boil the wood in caustic alkali under pressure, and failed to make suitable pulp for white paper,
210 and what is the highest pressure at which you tried and failed to make similar pulp, as near as you can recollect?

A. I can remember several times failing to produce pulp boiled in the mode you describe; but these failures did not, to the best of my belief, result from want of pressure. I cannot remember just now any boilings failing from want of pressure only.

Q. 121. What did they fail from?

A. The failures I allude to took place at Gray's Ferry, and they arose most frequently from water-logging the boiler and exhaustion of the liquor.

Q. 122. What was the pressure you were working under at that time, at Gray's Ferry?

A. We usually worked with a safety-valve, and blowing off at about 120 pounds.

Q. 123. How do you know that resinous wood could not be boiled under a pressure of fifty pounds in caustic alkali, and produce a pulp, without further treatment, except bleaching, which would make fair white paper?

A. My knowledge is obtained from the numberless experiments that I have made at various times since 1851.

Q. 124. Did you ever boil wood in caustic alkali, under a pressure of 40 pounds, with a view to making a pulp which would make fair white paper, without further treatment, except bleaching?

A. I cannot remember having made a specific experiment at a pressure of exactly 40 pounds, but it is highly probable that I have made such an experiment, among the various ones that I have made.

Q. 125. Can you state to me any pressure under 60 pounds which you can swear, as the result of your own experiments, will not make pulp fit for the manufacture of white paper by subsequent bleaching only?

A. I have made experiments at about fifty-five pounds pressure, I believe, by which I have produced a pulp that will bleach, with a considerable amount of bleach liquor, and which could be made into white paper by mixing with rag and other paper material; but I have not produced a really good pulp at this pressure, that I can remember.

Q. 126. What is the lowest pressure at which you have produced from wood a good pulp?

211 A. With non-resinous woods, with a quantity of alkali that contains about forty-eight per cent. of the weight of dry pulp, I do not think I have produced a pure pulp at less than one hundred and ten pounds pressure, or thereabouts; with resinous woods I have found that not lower than one hundred and twenty is necessary, with a rather larger proportion of alkali; but these conditions will vary with the age of the wood and its nature.

Q. 127. You have used the expression "good pulp;" do you mean by that any other than "pure pulp," which you used in your early answers, and from the pulp contemplated in your patent?

A. I do make a difference between the expressions "pure pulp" and "good pulp." By the words "pure pulp" I mean the purest form of pulp that can be obtained from vegetable substances; by the words "good pulp" I mean a pulp that shall bleach easily, and be converted into paper without any very large admixture of rag, rope, or similar fibre.

Q. 128. What percentage would you call a not very large admixture of rope, hemp, &c.?

A. From about eight to about fifteen per cent.

Q. 129. When did you first make a pulp and convert it into paper of the quality such as described by you, and with the quantity of bleaching mentioned by you, and the percentage of rope, rags, &c., mentioned in your last two answers?

A. I think not until 1856, because I do not remember the quantities of rag, &c., mixed with the pulp made at Gray's Ferrey.

Q. 130. What is the difference between the force of the words "good pulp," as used by you, and the pulp contemplated by your patent?

A. There is no difference.

Q. 131. In your several answers to me as to the lowest pressure at which you have worked, you have insisted on inserting in your answers that the words alkali solutions containing from seventy to eighty per cent. of the weight of the dry pulp produced in soda, in speaking of resinous woods, and forty-eight per cent. of the
212 weight of dry pulp produced, in speaking of non-resinous woods. Why do you introduce those conditions into your answer, as to the quantity of soda to be used in proportion to the weight of pulp to be produced, when I have not mentioned them in my questions?

A. Because the amounts of pressure necessary to obtain about the same quality of pulp must vary with the strength of the alkali employed. By the word strengh I mean the quantity of alkali.

Q. 132. Why did you select the particular amounts of alkali mentioned in that answer rather than any other amounts, and why did you deem it necessary to put in any amount of alkali at all in your former answer, when I did not ask about it in my question?

A. I selected that particular amount of alkali because it represents the hydrometrical strength of the solution of alkali, in proportion to the pulp produced in a more definite manner than if I had said so many gallons of a certain strength and so much wood; because an amount of soda equal to forty-eight per cent. of the weight of pulp represents one gallon of alkaline solution of 12° B., or 17° English, to the pound of pulp. I used this expression because you did not define the quality of pulp to which you referred, and the quality of the pulp depends on pressure and amount of caustic alkali.

Q. 133. I mean to inquire why you fixed upon 70 to 80 per cent. as the proportion of soda for resinous woods, and 48 per cent. as the proportion for non-resinous woods? Is it the usual proportion used by you for all temperatures and pressures, or does the quantity vary

with the different pressures? and how is a person to know what proportionate quantity of soda to use with any given pressures?

A. I fix on the quantity of 70 to 80 per cent. of soda in proportion to the weight of pulp, because I was at that time referring to a low pressure, and 48 per cent. because I was referring to a high pressure. 48 per cent. is the usual proportion used by us at our ordinary pressures, that is from 100 to 160 pounds. As the nature of the materials varies so very greatly, the quantity of soda to be used with any given pressure can only be learned by experience.

Q. 134. Do you use the same percentage with resinons and non-resinous woods? and if not, what is the difference in working at a pressure from 100 to 160?

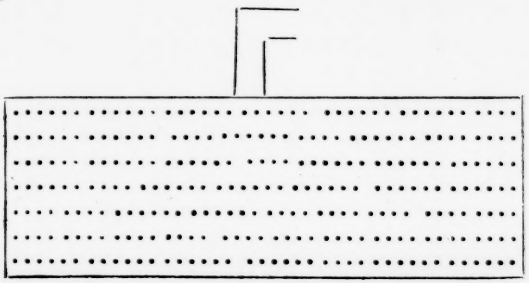
213 A. We do not use the same per centage with resinous and non-resinous woods. The percentage will vary from 3 to 10 per cent. increase of soda, according to the character of the resinous or non-resinous; resinous woods requiring an increase of from 3 to 10 per cent. over non-resinous.

OCTOBER 19*th*, 1866.

Present: Messrs. Wallace, Harding, and witness.

Q. 135. Describe particularly the apparatus first erected by you in this country at Gray's Ferry, in 1854.

A. The apparatus consisted of a rotary boiler capable of resisting two hundred pounds of steam pressure to the square inch. The boiler was about ten feet by three feet in diameter. It was an ordinary rotary rag-boiler. The man-head was in the centre of its length and heated by means of steam introduced through one of the trunnions or journals on which it revolves. This boiler was built by Joseph Aymer & Co., West Philadelphia. The apparatus for making caustic alkali was constructed of oil barrels. The boxes in which the pulp was exposed to the action of chlorine gas were made of wood, in which were racks to hold the pulp. I believe these boxes were about ten feet by four high. The racks within them were about eight inches or thereabouts apart, and extended the full length of the boxes and filled up all the area, leaving crevices between of about half an inch and extending the whole length of the box. The chlorine was introduced at the top of the box in such quantities as the stock or pulp would absorb; the top of the box being closed, the chlorine entered by a pipe through the top, in the manner shown in this sketch.



214 The supply of chlorine was regulated by the proper flow of muriatic acid on the manganese in an adjoining generating chamber or retort, or when salt and manganese were used to generate the chlorine gas, by the flow of sulphuric acid. This chamber or retort was connected by the means of a leaden pipe to the usual wash-bottles to purify the chlorine, from whence it was conducted, by means of another leaden pipe, to the gasing-box above described. If the liquid bleach powder in solution (hypochlorite of lime) was used, it was introduced into a wooden rag-engine provided with a roll or beater similar to the ordinary rag-engine. The pulp and water were introduced into the rag-engine with the above-named solution of hypochlorite of lime, the ordinary bleaching solution used for bleaching rags. The apparatus necessary for the manufacture of caustic alkali consisted of a series of oil-barrels or casks; steam was introduced by means of pipes into these barrels or casks. These casks were placed one above another, and the caustic alkali resulting from the decomposition of soda-ash by means of quick-lime was drawn from the upper into the lower casks, which were used as reservoirs.

Q. 136. Was this apparatus intended as a permanent or a temporary arrangement, and under what circumstances was it erected?

A. This apparatus was erected for temporary purposes, in order that Mr. Morris L. Keen and William F. Ladd, to whom F. B. Houghton had previously, or about that time, sold his interest in the Watt & Burgess patent, should have the means of examining into the value of the process.

Q. 137. What was Mr. Heughton's interest in the patent, and at whose expense were the works erected? who owned them, and who carried them on while they were carried on? how long were they carried on, and who finally disposed of them?

A. I cannot answer that question without referring to my papers. This apparatus was erected at, I believe, Morris L. Keen's expense. It was carried on by Mr. Keen and myself, I think till the end of January, 1855, I believe Mr. Keen disposed of what apparatus was sold.

215 Q. 138. Did you not sell all your interest in the patent on the 22d of November, 1854, to F. B. Houghton?

A. Yes, I disposed of all the interest of Watt and Burgess to Mr. F. B. Houghton.

Q. 139. What interest had you in the patent after that date, and how did you acquire it?

A. Messrs. Ladd and Keen offered to give me one-third share if I would remain in this country. I have that share now.

Q. 140. When did you acquire that share, and how?

A. This offer was, I believe, made in 1856, and I accepted it at that time.

Q. 141. By what title did you acquire that interest?

A. No titles were made out. There were no papers. But when a division of profits was made, I received my one-third share.

Q. 142. What was paid by Mr. Houghton for the patent?

A. I cannot reply to that question precisely till I have examined my papers.

Q. 143. State as nearly as you can what consideration you received personally from F. B. Houghton?

A. I believe my share was about two thousand pounds, received from F. B. Houghton, in the shape of his notes, some of which have not been paid.

Q. 144. Did Mr. Houghton propose or take any part in the erection or works at Gray's Ferry?

A. Mr. Houghton was a great deal at Gray's Ferry whilst the experiments were being made; but cannot state whether he found any means for the purpose of erecting the apparatus and carrying it on.

Q. 145. You yourself did not furnish the money for erecting the works or carrying on the experiment?

A. No, sir.

Q. 146. What service or consideration were you to give to Messrs. Ladd & Keen for the third interest in the patent which they gave you in 1856?

A. This interest was given to me in consideration for my services in working of the process of the Watt and Burgess patent in connection with them.

216 Q. 147. What amount of pulp was sold at Gray's Ferry, and what profit realized?

A. The amount of pulp sold I cannot state, as I do not know that any money was received for the paper that was made out of it, and therefore cannot state what the profit was.

Q. 148. Were the Gray's Ferry works the first attempt that you know of to make pulp suitable for the manufacture of paper, on a working scale, under the Watt and Burgess patent?

A. Yes.

Q. 149. Prior to that the invention had gone no further than laboratory or room experiments?

A. I made perhaps half a ton of pulp in England under the Watt and Burgess patent. I suppose you would call it a laboratory experiment. It was not at a paper-mill.

Q. 150. Did Mr. Watt take any part in that experiment?

A. He was present, I believe, several times. His health at that time confined him closely to the house.

Q. 151. What was the object of making that half ton of pulp?

A. It was to ascertain if such pulp would make paper, and this pulp was made into paper.

Q. 152. When was this experiment made?

A. In 1853; about the summer or autumn.

Q. 153. Did you wish to satisfy any one besides yourselves that paper could be made out of it?

A. It was to show some gentlemen the process whom I wished to take an interest in it.

Q. 154. What did you do with the pulp made?

A. It was sent to a mill, at Boxmoore, to be converted into paper.

Q. 155. Did you bring any of the specimens of that pulp to this country?

A. I do not think I did.

Q. 156. Are you certain you did not.

A. I am nearly certain, but I cannot be sure. I may have had some small samples.

Q. 157. Did you not send samples of that pulp to Washington, to the Patent Office?

217 A. I do not think I did. To the best of my belief I prepared the samples which I sent to the Patent Office, in Washington, while in Washington.

Q. 158. Did not Mr. Watt ever visit this country, to your knowledge?

A. No, sir; he did not.

Q. 159. Describe the apparatus in which you made the specimens of pulp in England—the half-ton specimen?

A. The shavings of pine wood were boiled in an open boiler, in a solution of caustic alkali, the strength of which I cannot now remember. These shavings were boiled perhaps sixteen hours; they were then put into a temporary box, and exposed to the action of hypochlorous acid gas, generated from bleach powder by means of sulphuric acid. They were then washed and exposed to a weak solution of alkali; then they were washed and bleached.

Q. 160. Describe the apparatus erected at Royer's Ford. When was it commenced and when was it completed?

A. The pulp works were commenced at Royer's Ford, I believe, in the spring of 1855, and, I believe, completed early in the spring of 1856. The apparatus erected consisted of two rotary boilers, I believe, 24 feet long by, I believe, 6 feet in diameter. They were provided with two manheads and large cocks for blowing out of the pulp. The steam was introduced for heating those boilers by the usual mode through the trunnion. Both the boilers for generating steam to heat the rotary boilers and the rotary boilers themseives were of usual strength, calculated to resist over two hundred pounds; were half-inch iron and were double riveted. A novel mode of previously heating the alkali was adopted, for which purpose we used, as a heater, the small rotary boiler which we had used at Gray's Ferry. The tanks used for making the caustic alkali were of iron, provided with stirrers and proper arrangement of steam-pipe for heating. A furnace was erected for the recovery of the alkali; steam was introduced into one of the large rag-engines for the purpose of heating the alkali which we used on the pulp after our first treatment with bleach powders, and previous to the second treatment with the bleach. The rest of the apparatus simply related to the ordinary paper-making. We did not have any racks here, but
218 used the rag-engine somewhat in the same mode as that used at Gray's Ferry.

Q. 161. How did you discharge the contents of those boilers?

A. The majority of the contents was discharged through the cocks mentioned. The remainder of the pulp through the open man-holes. The quantity discharged through the cocks would depend upon the material used, whether it was straw or wood.

Q. 162. What was the dimensions of these cocks, and in what part of the boiler were they placed, and what kind of cocks were they? How many of them were there?

A. I believe the dimensions of these cocks were either two and a half or three inches; they were of cast-iron plug-cocks; the ordinary cast-iron plug-cock, nothing peculiar about it. They were placed in a direct line, three in number to each boiler, immediately opposite the man-heads, so that on opening all the three cocks at the same time a large proportion of the contents was blown out; the supply of steam at the trunnions being stopped off, unless we had occasion to turn it on to aid in the discharge of the boiler, which was but seldom.

Q. 163. When did this apparatus described by you get into operation at Royer's Ford? by whom was it owned, and by whom was it run?

A. This apparatus got into operation at Royer's Ford in March or April, 1856. I believe it was owned by Mr. Ladd, and the works were carried on by Mr. Ladd, Keen and myself, as co-partners, I suppose.

Q. 164. What kind of wood did you work in that apparatus when it started, and what was done with the pulp made?

A. I was not at Royer's Ford when the work started, but I believe the wood used at that time was poplar; soon after we started we used red cedar, and have used at various times white pine and hemlock, and also straw. I was there at the end of April, and, to the best of my belief, we were working poplar and red cedar, which is a resinous wood. The pulp made was converted into paper upon the ground.

219 Q. 165. How long did you continue to use that apparatus at Ford?

A. We used this apparatus till the mill closed, in the spring of 1857.

Q. 166. When did you first work with straw?

A. To the best of my belief, we worked straw soon after I arrived at the mill.

Q. 167. Who conducted the pulping operations at Royer's Ford after you came there in April, 1856?

A. I believe chiefly myself, though Mr. Keen and I always consulted together.

Q. 168. Do you continue to work cedar?

A. No, we do not.

Q. 169. Why not?

A. On account of its expensiveness.

Q. You have said that the mill at Royer's Ford closed in 1857; why was this?

A. On account of the general badness of the times, most of the paper mills having closed.

Q. 171. When did you resume operations at Royer's Ford, and under what auspices or control?

A. In August, 1859, when we commenced using the hot-water

process for making brown paper, under the auspices of the same parties. The mill property always belonged to J. & D. George.

Q. 172. What was the arrangement you had with them?

A. I cannot answer this question precisely, as I know very little of the business relations held between Messrs. Ladd and George.

Q. 173. Did not they, Messrs. George, furnish the money for some of the apparatus, and did you not pay them rent for the use of it?

A. To the best of my belief the Messrs. George furnished means for the patent boilers erected in 1859, with the understanding that they were in exchange for the various apparatus adapted for ordinary paper-making put in by Mr. Ladd, such as the rotary boilers and attachments; the understanding being that all these should become the mill property of Messrs. George, and should be left as fixtures when we left.

Q. 174. Describe what you call the patent boiler with
220 which you worked on straw in 1859, in making brown paper by what you call the water-process.

A. The boiler is of a cylindrical form, placed in upright position, so that heat can be applied at the lower end; it is provided with a valve or gate at the bottom to discharge the contents of the boiler; near the top there is a pierced diaphragm of tank iron to keep the material submerged under the solution with which the boiler is charged. The boiler is provided with the ordinary safeth-valve and steam-gauge.

Q. 175. In what part of the year 1859 were the said boilers erected, what were the dimensions and the number?

A. The boilers were erected early in the summer of 1859. I believe their dimensions are sixteen feet high by four feet six inches in diameter; they four in number.

Q. 176. What amount of straw was pulped in them during the months from August 1859 to January, 31, 1860?

A. 52,749 pounds.

Q. 177. Were those boilers, or some of them used daily during that time in working straw?

A. With the exception of December, 1859, and January, 1860, some one or more of to boilers appear to have been worked, from the record of my note boek, nearly every day, and about sixteen days in January.

Q. 178. What was done with the pulp made in those boilers during that time?

A. It was made into paper on the ground, and sent to Philadelphia market.

Q. 179. When did you cease working on straw by the water process, and what did you do then?

A. Apparently in February 22d, 1860; we then went on to manufacture white paper nearly all made of rags, till September 8th, 1860. The mill was then altered to a certain extent; the evaporationg furnaces for the recovery of alkali were put up in an improved form, and we used rag, straw, and wood, for paper making; sometimes using less rag, sometime more, as our supply of wood and straw enabled us.

Q. 180. Please furnish me, from the books of your firm, with the proportions of wood, straw and rags used at Royer's Ford in 1860, 1861 and 1862, and the kind of wood.

(Question withdrawn.)

221 Q. 181. Please produce your notes of the boiling account during 1856, 1857 and 1859.

A. These are my notes I now produce.

(Mr. Harding requested the commissioner to copy the notes and mark them as Exhibit 54.)

Adjourned to October 22d, 1866.

OCTOBER 22, 1868.

Present, counsel for respective parties.

Q. 182. Furnish me as nearly as you can the amount of wood, straw, and rags used by you in 1860, 1861, and 1862.

A. The amount of straw used in 1860 appears to be about forty-seven tons, the amount of wood about seventy and one fourth cords, and about fifteen tons of fine sawdust or shavings; this wood was poplar and hickory. The production of all the mill in this year was from eight to twelve tons per week; the remainder of the stock, besides the straw and wood above given, consisted of rag. The rag yields about sixty per cent of paper, and wood about thirty-five, and straw about thirty-eight per cent. In 1861, the amount of straw used appears to be about five and a half tons, and wood thirty-six and a half tons; the production of the mill is about the same as 1860, the balance of the stock being rags. In 1862, up to April, four and a half cords of wood were used; there appears to be no straw used this year; the balance of paper material up to April, 1862, was rags; the entire weekly production was as before stated. In 1861, the wood used was hickory; 1862, all poplar. From April, 1862 to August, 1862, we were under repairs, fitting the mill generally, previous to our making wood pulp exclusively.

Q. 183. When did you first begin to sell wood pulp as an article of manufacture to be manufactured by others into paper?

A. We sold one lot in 1860; about five tons made of white pine. I do not remember at this moment selling any more wood pulp as an article of manufacture till 1862.

Q. 184. At what pressure and what degree of strength of alkali, by the hydrometer, did you cook straw in 1856?

A. Our usual pressure was about one hundred and sixty

222 pounds; we appear to have used about 70 gallons of caustic alkali of the strength of five and a half Twaddell to the one hundred pounds of straw, equivalent to about three and one-fourth Beaume. That is about the proportion we generally used with straw, except in 1859, when we used but very little alkali. The bulk of the paper being made without alkali in 1859.

Q. 185. Were the wood and straw which you cooked from 1859 down to 1863 cooked in the four vertical boilers erected in 1859?

A. Yes, they were.

Q. 186. Are those boilers still in use?

A. Yes, they are.

Q. 187. Have those boilers been sold by the Messrs. George?

A. Those boilers belong now to the American Wood Paper Company, who purchased them of Mr. Ladd.

Q. 188. When did the American Wood Company purchase them from Mr. Ladd, and acquire the ownership?

A. I can not exactly state when Mr. Ladd and the Messrs. Georges made the arrangement for the exchange of these upright for the rotary boilers. This was, I believe, in 1862. The American Wood Paper Company came into possession of these at the time they purchased the whole works of the Messrs. Georges. That was in the summer of 1866.

Q. 189. Please examine Exhibit N, annexed to complainant's bill, and the drawing annexed thereto, a copy of Morris L. Keen's patent of June 16th, 1863, and state whether that is a correct representation and description of the said upright boilers erected at Royer's Ford, in 1859, of which you have spoken?

A. The Exhibit N is a correct representation of the boilers erected at Royer's Ford, in 1859, with the exception that it does not show the lower diaphragm or screen which we used about that time.

Q. 190. Is not that exhibit a correct representation and description of the four boilers at first erected at Royer's Ford, and as they first went into use, and were not the lower screens to which you allude applied to only two of the four boilers, and these only when straw was being cooked?

A. The exhibit is a correct representation of the boilers
223 as first erected in 1859. The lower screens alluded to by me in my last answer were, to the best of my belief, only attached to two boilers, and I believe only when we were boiling straw or corn-stalks.

Q. 191. The exhibit then is a correct representation of the condition of two of those boilers, from 1859 down to the time when the American Wood Company bought them of the Messrs. George?

A. It is.

Q. 192. Who built those boilers?

A. Stanhope & Supplee, of Frankford.

Q. 193. What was the object of those lower screens when you did use them?

A. It was for the purpose of having a lower water-space, for the purpose of aiding the circulation of the liquid contents of the boiler, and also to prevent the risk of any thing like burning the bottom of the boiler, when we used limy solutions.

Q. 194. When and for what purpose did you use limy solutions?

A. In making a better class bastard manilla we were accustomed to include a little lime to improve the color of the pulp.

Q. 195. Why did you not use the screens with wood?

A. On account of the wood retaining its shape in the boiler, the liquid had free circulation through the open mass of material in the boiler.

Q. 196. Is it very important in cooking straw to have as thorough a circulation as possible?

A. In boiling by direct heat, there is great risk of burning the bottom of the boiler, unless a free circulation of the fluid is maintained.

Q. 197. Is that the only advantage of full circulation?

A. And also the great advantage of the convective currents of liquor equalizing the strength of the solution in all parts of the boiler.

Q. 198. Then I understand that the circulation of the liquid is important in cooking straw?

A. The circulation or mixing the liquor is important in cooking straw.

224 Q. 199. When did you first apply the method of blowing off the entire contents of your boiler under pressue, in practice, and what advantage, if any, was gained thereby?

A. In practice, we did not adopt the plan of the entire discharge of the boiler by blowing out the contents of the boiler while under pressure, till 1859. We put up an experimental boiler in 1858.

Q. 200. Describe that experimental boiler.

A. I believe the boiler we made use of was a small rotary used at Gray's Ferry, placed in a vertical position, with a discharge pipe at its lower end, and heat applied at the bottom of the boiler. When the charge was cooked, the boiler was discharged by means of the pipe at the bottom, which was supplied with a cock for the purpose, which was, I believe, the ordinary cast-iron cock. I cannot give the size of this cock. It was large, I believe, because we discharged the contents of the boiler through it.

Q. 201. Please state the advantages of blowing off the contents of the boiler under pressure?

A. The advantages gained by this mode of discharging the contents of the boiler under pressure are the ease and rapidity of emptying the boiler and the opening out of the stock by the discharge, and thus rendering it easy to be washed.

Q. 202. Examine Exhibit L, complainants', and state whether you have ever seen used a boiler having the arrangement of stirrers and discharge-cock, such as shown there in discharge-valve "G," such as shown in the drawing annexed to said patent?

A. No, sir; I have not.

Q. 203. Could such an arrangement be used in cooking straw or wood, in the condition in which you cook it?

A. I see no reason why it could not.

Q. 204. Do you know why such apparatus was never used?

A. This drawing, marked Exhibit L, is merely a copy of a little tin model made by Mr. Keen and lodged in the patent office, to show the principle of discharging a boiler under pressure.

(Objected to by Mr. Harding as not responsive.)

Q. 205. Question repeated.

225 Because the form adopted practically by Mr. Keen was considered as better adapted for the purposes he had in view at the time of erecting such boilers.

Q. 206. What was the objection to the use of stirrers, if any? and if you have never used them state why not.

A. The objection we foresaw in the use of the stirrers, when heat-

ing the boilers by direct heat, was that, as the vegetable materials became softened by the caustic alkali, the stirrers would reduce it to a pulpy mass, which would lay at the bottom of the boiler, prevent circulation, and thereby endanger the burning the bottom of the boiler. There would be no objection to the use of stirrers if any other mode of heating than that by direct heat was made use of.

Q. 207. What was the objection, if any, to the arrangement of the piston or plug "G?"

A. There is no objection at all to the plug "G." It is a poor mechanical contrivance, and only placed in the model from which the drawing is taken to show the principle.

Q. 208. Have you ever used the stirrer or plug-cock in practice?

A. We have not.

Q. 209. Have you ever used try-cocks, placed at various elevations in the boiler, for the purpose of testing the degree of perfection to which the stock is worked, such as is marked at "O?"

A. I believe we used them in our experimental boiler in 1858, but not in practice.

Q. 210. Had you no try-cocks on your rotary boiler, in 1856?

A. We had them in our rotary boilers in 1856.

Q. 211. Was it through those try-cocks that you occasionally blew off portions of the contents of the boiler?

A. These cocks that I alluded to in my last answer, were about two and a half inches in diameter, and we used them as try-cocks and as discharge-cocks.

Q. 212. What is your interest in the American Wood Pulp Company?

A. My interest is about one-third share of the amount paid by the American Wood Paper Company for the Watt and Burgess patent.

226 Q. 213. State precisely the amount of stock you own in the American Wood Pulp Company?

A. I own about nine hundred shares.

Q. 214. What is the capital of that company and what the total number of shares?

A. The capital is two millions, and shares one hundred dollars each.

Q. 215. What position or office do you hold under said company?

A. The position of chemist for the company.

Q. 216. What's your salary?

A. Five thousand dollars a year.

Q. 217. In working upon straw in 1856 and in 1860 and in 1861, did you consider that you were working under the Watt and Burgess patent, or under Mellier's patent of May 26, 1867?

A. I considered that we were working under the Watt and Burgess patent in the years 1856, 1860, and 1861.

Q. 218. Why did you not consider that you were working under the Mellier patent.

A. Because I believed that the Watt and Burgess patent covered the process of boiling straw by caustic alkaline solutions, under pressure.

Q. 219. When did the American Wood Paper Company purchase the said Mellier patent, and were you consulted about said purchase?

A. It was bought of Coe S. Buchanan, October 14, 1863. I do not remember being consulted at all on the purchase of that patent.

Q. 220. Do you know what was paid for that patent by the American Wood Company.

A. I don't know.

Q. 221. Did you ever hear from any of the officers of that company?

A. I do not remember to have heard from any one what was the amount paid for that patent.

Q. 222. Do you know whether your company now claim exclusive right to make pulp by boiling straw in caustic alkali under pressure by the Mellier patent or by the Watt and Burgess patent?

227 A. I believe by the Watt and Burgess patent.

Q. 223. Who acted as your agent or counsel in procuring the several Watt and Burgess patents and reissues in this country.

A. Mr. A. B. Stoughton, of Washington.

Q. 224. Did Mr. Thomas A. Jenckes confer with you in reference to either of the reissues or take any part in reference thereto?

A. He advised that they should be taken out, Nos. 1,448 and 1,449, the reissues of 1863.

Q. 225. Do you know whether he acted in connection with taken them out?

A. I believe he was consulted about the claims.

Q. 226. He is the president of the American Wood Company, I believe?

A. He is.

Q. 227. What is the highest pressure and corresponding temperature at which you have worked practically at pulping wood with any strength of caustic alkali?

A. The highest amount of pressure I remember to have used in boiling wood was about 200 pounds to the square inch, which, with a strength of liquor 17°, (English), would be. I think, at a temperature of about 400°, I believe; I have not the the tables here.

Q. 228. What is the highest pressure at which you have tested experimentally the working of wood with any stength of alkali? and what means did you adopt to ascertain the pressure at the time?

A. I believe the highest pressure that I have experimentally used is about 300°, in boiling wood in caustic alkali. The means used to measure that pressure was a steam gauge made expressly for us.

Q. 229. When and where was this done first?

A. This was done in 1856, at Royer's Ford.

Q. 230. What is the minimum pressure at which you have worked practically in converting wood into pulp by boiling in caustic alkali of any strength? I mean by the one-stage process, and not by the tri-stage process, of boiling in caustic alkali, chlorine, and alkali in succession; and state for how long a time you worked at that minimum pressure?

228 A. Do you mean by practically working serviceable pulp?

(Mr. Harding replies yes, and the witness continues.)

The minimum pressure at which I have practically converted wood into pulp by boiling in caustic alkali has been as low as sixty pounds. This was done, to the best of my belief, perhaps two or three times since 1856.

Q. 231. What is the minimum pressure at which you have worked as a regular thing, in practice?

A. The minimum pressure at which we have worked in practice has been about one hundred and thirty pounds.

Q. 232. What reason have you, if any, for working in practice from 130 up to 190 pounds, as heretofore stated by you, instead of working as low as 60, pounds and as high or higher than 300 pounds?

A. The advantages of working at 130 pounds, instead of 60 pounds, is that with the same amount of alkali a better pulp is produced in a much less time, as 130 pounds with most woods effects this object. It is no advantage using a higher pressure. We increase the pressure above 130, according as the age and nature of the wood render necessary, up to 190, which appears to succeed for every wood, except red cedar, which wood I have never succeded in bleaching, except by the chlorining and realkaline process.

Q. 233. When did you first succeed in pulping red cedar so as to make a white pulp?

A. We only converted red cedar into bleached pulp on a small scale, as we found a ready demand for the partly bleached paper from this wood. It was in 1856 I first did this.

Q. 234. Is there any wood which cannot be thoroughly pulped into serviceable pulp by the one-stage caustic alkali process under pressure?

A. I am not aware that there is any.

Q. 235. Is it your practice to convert any resinous woods into pulp by the one-stage process? and if so, what resinous woods by said one-stage process?

A. It has been, and is, to convert the resinous woods used by us which have been principally white and pitch pine and a small quantity of red cedar.

Q. 236. If increasing the temperature and pressure to 130
229 and 190 pounds improves the quality of the pulp and diminishes the time why do you not increase the temperature still higher and obtain an increase of the same beneficial results?

A. Because at the temperatures and pressures above named all or nearly all the intercellular tissue is removed, and consequently there would be no advantage in increasing the pressure and temperature.

Q. 237. Do you mean that the time would not be shortened if you should increase the pressure and temperature?

A. It probably would, but the advantage would be counterbalanced by the increased expense in fuel and the unnecessary straining of the boiler.

Q. 238. Have you not noticed in some of your experiments at pressures above two hundred pounds the pulp was injured from excessive heat?

A. I do not think any injury can accrue to the pulp from exces-

sive heat at about or above two hundred pounds presseure if there has not been an excess of alkali. If there is an excess of alkali between pressures of two hundred and three hundred pounds there is danger of injuring seriously the pulp by destroying the wall of the fibre or cellulose—decomposing it.

Q. 239. Is it safe, in your judgement, to work above two hundred pounds? and if so, how much above two hundred pounds pressure, with any strength of alkali?

A. It would be safe to work at about two hundred pounds pressure on old and well-seasoned pines. I do not think it would be safe above two hundred and twenty pounds pressure for any kind of wood, if there is an excess of alkali.

Q. 240. Do you know, from experimental or from practical working, anything about the effect of pressure above three hundred pounds? and if so, state the experiment and pressure at which it was tried?

A. I do not.

Q. 241. Did you draft the reissued Watt and Burgess specifications of 1863?

A. I drafted them.

Q. 242. Please give me the date of the first occasion in which you converted wood into pulp at a presure of sixty pounds, as mentioned by you in your former answer—I mean by the one-stage process?

230 A. That was in 1856, I believe.

Q. 243. Please give me the date at which you first converted wood into pulp at so high a pressure as one hundred and ninety pounds?

A. That was in '56 or 57.

Q. 244. When was it you first ascertained by experiment that one hundred and twenty to one hundred and thirty pounds was the minmum pressure at which you could obtain nearly all the cellulose or pulp, and was the lowest pressure at which it was best to work in practice?

A. That was in 1856.

Q. 245. When did you first ascertain that resinous woods could be pulped by caustic alkali undhr pressure as a one-stage process as readily as non-resinous, provided the pressure was increased with resinous over non-resinous?

A. It was in 1851.

Q. 246. At what pressure did you then discover that resinous woods could be pulped by the one-stage process, and how did you measure pressure at the time?

A. I did not measure pressure at the time, and, therefore, cannot state what amount I used.

Q. 247. If you knew in 1851 that resinous woods could be pulped by a one-stage process in caustic alkali under pressure, why did you not described that one-stage process of converting resinous woods by boiling in caustic alkali under pressure alone in your provisional specifications filed in England, the 14th of August, 1853, instead of setting forth a tri-stage process of boiling in water, treating in sulphurous acid, and then a warm caustic alkali?

A. Because, from the quantity of alkali necessary for the pulping of wood, it appeared to me that the process would be too expensive for practical purposes. I therefore did not include it as a whole process in the provisional specifications of August 19, 1853, there being one or two other processes which are omitted for the same reason. I put in sulphurous acid and the chlorining process, because I believed it to be a fairly cheap mode of obtaining wood pulp.

Q. 248. Please produce your original note-book of 1854?

A. I produce the same.

(Mr. Harding requests the Commissioner to copy and an-
231 nex, as an Exhibit No. 57, all of said book which relates to the manufacture of pulp, being the first fifteen pages. And, also the notes in said book in reference to experiments, April 29, 1856, on page 30.)

Q. 249. Please produce a specimen of unbleached wood pulp made by the one-stage process of boiling in caustic alkali under pressure without any chlorine treatment whatever, as now manufactured by you.

A. I produce specimen marked Exhibit 58.

Q. 250. When did you first agree with Mr. Watt that you and he should be jointly interested in a patent or invention for making pulp?

A. In 1851.

Q. 251. Did Mr. Watt try any experiments or take part in any?

A. Yes, sir, he did.

Q. 252. What was the nature of the agreement between you made in 1851?

A. It was, that if anything resulted from the experiments we should halve the proceeds. I believe it was half, though I think Mr. Watt was to have, slightly, an increased share, on account of his first suggesting the idea of pulping wood by chemical means.

Q. 253. In 1853 you and he determined upon the process for which you applied for an English process, as being the process which you intended to introduce into practice out of the numberless experiments which you had tried?

A. We did.

Q. 254. When did you so develope your experiment of 1851 as to ascertain the pressure and length of time and the proper quantity of alkali to be used in converting resinous woods into pulp practically?

A. I did not ascertain the precise amount of pressure necessary to pulp resinous woods until 1856. I fixed about the amount of alkali necessary for this purpose in 1851, and the length of time, with but one strength of alkali, however.

Q. 255. What advance did you make beyond that from 1851 to 1856, and when did you and Mr. Watt make any advance beyond that point?

A. I made no advance further than that until 1854, August,
232 1854, when I was able to more closely calculate the pressure necessary to pulp wood by boiling in caustic alkali, as I had some means of determining the pressures. I believe this was in August, 1854.

Q. 256. Had Mr. Watt anything to do with this last development?

A. No, he had not.

Q. 257. Please state in which of the several specifications of the Watt and Burgess patent is announced your alleged discovery of 1851, that by the one-stage process of boiling in caustic alkali, under pressure, resinous woods can be converted into pulp, and quote the words which announce that scientific fact? I allude to your first and second English specifications and your three American issues.

A. I intended to cover it in the specification of 1854, by the words: "We find boiling in a solution of caustic alkali, under pressure, of great service.

(Answer objected to as irresponsive.)

Q. 258. Is it or is it not announced in that specification of October, 1854, that boiling resinous wood in caustic alkali, under pressure, will convert into pulp?

A. It is not so stated.

Q. 259. In which of the five specifications which you have drawn at various times is the fact stated that by boiling resinous woods in caustic alkali, under pressure, as a one-stage process, pulp would be produced?

A. Not until the reissue of 1,448, 7th of April, 1863.

Q. 260. Quote the words which announce it in that, to wit, that by boiling resinous woods in caustic alkali, under pressure, as a one-stage process, pulp will be produced?

A. "By the words 'under pressure' is meant a pressure near or above 300° Fahrenheit, which is the ordinary pressure used, but a heat and corresponding pressure of from 300° to 500° may be used, according to the nature of vegetable substances to be used, whether resinous or non-resinous. * * * After the vegetable substances have been thus operated upon by caustic alkali, under heat and pressure for the requisite time, as above described, it should be discharged from the boiler under pressure into a tank or other reservoir,
with proper safety-valves and pipes for the discharge of the
233 steam, and should be drawn as soon as the steam shall have escaped into open vats, where it can be operated upon in the next stage of the process, as it may be drawn directly from the vats into the boiler. The vats which receive the wood shavings or cuttings, or other vegetable substances, being formed into pulp, should be constructed with suitable means of drainage. The alkaline solutions must then be removed from the pulp, either by percolation and subsequent washing in the vats, or by pressure in any convenient apparatus and subsequent washing. The mode of percolation has generally been found sufficient. The alkaline solutions thus obtained may be saved and evaporated down, and the residuum burned in a furnace suitably constructed, so as to prepare the alkaline substances for use in a repetition of the same process. The alkaline solution having been removed by percolation and washing, or by pressure and washing, the wet mass of woody or vegetable pulp is now exposed to the action of chlorine or the compounds of chlorine with oxygen, for the purpose of bleaching it and preparing it for the manufacture of white

paper. Brown-colored or unbleached paper of a good quality can be produced from the pulp as soon as the alkaline solutions are removed, but for the production of good white paper it is necessary to subject the pulp to a bleaching process."

Q. 261. How much were you paid for the Houghton notes? and how much did you realize for the sale of the Watt and Burgess patent to Houghton?

A. The bulk of the notes was not paid. I will bring the amount that was paid at our next meeting.

Adjourned to October 25, 1866.

OCTOBER 25, 1866.

Present: Counsel for respective parties.

Q. 262. How much cash did you realize yourself from the sale to Houghton?

A. One hundred and eighty-six pounds.

Q. 263. Was Mr. Houghton present at Royer's Ford about the time of your starting there?

234 A. I believe he went down to Royer's Ford; but of this I am not quite sure.

Q. 264. Were you present at Washington, in person, at the time of your first application for an American patent? and where did you prepare your specimens there?

A. I was present at Washington at the time referred to. I prepared the samples of pulp, or part of the sample lodged in the Patent Office, in one of the rooms of the commissioner.

Q. 265. In working the tri-stage process on such woods as deal and fir, please state the strength of the alkali by the hydrometer, the number of gallons per 100 pounds of material usually used, the pressure and the length of time in boiling of the first stage of the tri-stage process?

A. In working the tri-stage process the strength of the solution of caustic alkali would vary with the condition of the wood we wished to produce by means of the boiling. When we only removed the resinous oils we would use caustic alkali of the strength of about 10 English hydrometer. When we wanted to remove more of the intercellular tissue we would increase the strength of the solution of caustic alkali to about 17 or thereabouts. The number of gallons would depend more or less upon the condition of the wood. When the resinous wood was dry we used about 30 to 40 gallons to the 100 pounds of material at 17 English, if we wished to produce a pulp; if we only wished to produce wood in a chippy form we would use caustic alkali at a strength of about 10, and at the rate of about 30 or 40 gallons to the 100 pounds. Pressure usually used by us was about 100 to 120 pounds. The length of the time would depend very much as to the water logging or otherwise of the boiler. When the boiler did not water-log, I believe we used to occupy perhaps from six to eight hours.

Q. 266. Where was it that you first adopted 100 to 120 as your usual pressure, and when?

A. At Gray's ferry, in 1854.

Q. 267. At what pressure was the first stage of your first operation at Gray's ferry upon your notes conducted?

A. It was boiled in an open vessel, and consequently at no pressure. That was August 20, '63.

235 Q. 268. What is the first experiment in your note-book which bears a date after August, 1854?

A. December 7, 1854.

Q. 269. So far as the tri-stage process is concerned, was boiling under pressure of any advantage?

A. It was of considerable advantage.

Q. 270. In point of time or economy?

A. In point of time; and it was more economical.

Q. 271. Why did you fix 10 to 12 degrees English hydrometer for working resinous woods in your last reissue, and 17° English for non-resinous?

A. We only use 10° English hydrometer strength of caustic alkali when we adopt the tri-stage process, in order to remove the resinous oils, which removal is necessary to enable to chlorine to act on the intercellular tissue. We use 17 English hydrometer caustic alkali when we wish to remove all or nearly all intercellular tissue by means of caustic alkali.

Q. 272. Question repeated.

A. We fixed upon the use of caustic alkali of the strength of from ten to twelve English hydrometer for resinous woods in our last re-issue, because we had always found that to be about the smallest quantity we could effectively use in the tri-stage process, and we fixed upon seventeen English hydrometer as the strength of the caustic alkali in boiling non-resinous woods, as we had always known that to be about the necessary strength.

Q. 273. Then, if you were to use the strength of caustic alkali laid down in that last re-issue for the resinous woods, you could not produce pulp unless you worked by the tri-stage process?

A. With such a strength of caustic alkali—that is, from 10° to 12° English hydrometer, the wood might be partly disintegrated or pulped; but in order to produce a nearly pure pulp, the tri-stage process would have to be adopted.

Q. 274. Then, in announcing that strength of alkali, to wit, 10° to 12° English, in connection with resinous woods, and announcing no other strength in connection with resinous woods, you contemplated the treatment of resinous woods by the tri-stage process only in that re-issue?

236 (Question objected to by Mr. Wallace, and the witness instructed by Mr. Wallace not to answer the question, as calling upon him for a construction of the patent, which, as an expert, he is not obliged to give.)

(Mr. Harding asks the witness to answer the question, and will take the risk of having the question answered by the witness in any capacity whatever, whether as an expert or as the testimony of the party who has sworn he drew the specification.)

A. We did not contemplate using the tri-stage process only in the

re-issue referred to, of resinous woods, because we announced that the varied nature of the vegetable substance to be acted upon is such that only general directions can be given for the strength of the alkali, or the degree of heat to be used, or the duration of the operation. The words, "the varied nature of the vegetable substance to be acted upon," refer to resinous woods, or any other kind of wood.

Q. 275. You state that for deal, pine, or fir wood, a strength of 12° (English) is sufficient, and you state that for non-resinous wood a strength indicated by 17° (English) answers very well. In giving those proportions, did you not contemplate that the non-resinous wood was to be worked by the one stage process, and the resinous wood by the tri-stage?

(Objected to by Mr. Wallace.)

A. Yes.

Q. 276. In working the one-stage process, do you not require a higher strength of alkali for resinous than for non-resinous woods?

A. Yes.

Q. 277. Are there any words in the specification that state that a higher strength of alkali must be used for resinous than for non-resinous woods, if the one-stage process be adopted?

A. No; no definite quantities are stated.

Q. 278. Question repeated, and the witness requested to quote the words which state that with resinous woods a higher strength of alkali is required than with non-resinous.

(Objected to by Mr. Wallace.)

A. The words that refer to the fact that a higher strength of alkali is required with resinous than with non-resinous woods
237 are "the varied nature of the vegetable substance to be acted upon is such that only general directions can be given for the strength of the alkali."

Q. 279. Do those words convey, in your judgment, that impression to a person reading them, to wit, that resinous woods require more alkali than non-resinous.

A. Yes, they do, inasmuch that the resinous wood is of a varied nature from non-resinous.

Q. 280. Do not the words "varied nature of vegetable substance" apply to all vegetable substances? and do they not include straw as well as wood?

A. The words refer to all vegetable substances, and to straw as well as wood.

Q. 281. On one or two occasions, you say, you have worked wood at sixty pounds pressure. What was the strength of alkali, and what was the length of time the process occupied, and what was the date of the first experiment, as near as you can give, at that pressure, and how did you measure the pressure at that time? Answer as to both kinds of wood.

A. I believe I worked at sixty pounds pressure with resinous wood when I had the means of measuring the pressure, which was by a steam-gauge, in 1856. The strength of alkali used would be about seventy to ninety per cent. of the pulp produced in weight with non-

resinous woods at the same pressure at about forty-eight per cent. of the weight of the pulp. I cannot remember the length of time as to either wood.

Q. 282. Question repeated. I do not ask you what would be the strength of alkali, but what was the strength of alkali used by you?

A. I cannot answer this question unless I know what experiment it may refer to.

Q. 283. Mr. Harding says his question refers to the first time you tried an experiment yourself, in an apparatus having means of ascertaining pressures and pulp-wood by a single operation in caustic alkali, under pressure at or below sixty pounds pressure; you yourself knowing at the time what the pressure was.

A. I pulped resinous wood into a not very pure pulp in 1856, at a pressure of sixty pounds. The strength of alkali, to the best
238 of my recollection, was from seventy to ninety per cent. of the weight of pulp produced with resinous woods, and with non-resinous woods, in 1856, when I first had the means of measuring pressures. I cannot remember the hydrometer strength of the above solutions, or the number of gallons. I cannot remember the length of time in either case.

Q. 284. Please state to me the circumstances which led you to try that experiment when you first tried it in 1856?

A. I was led to try that experiment in 1856, in order to confirm the knowledge I had obtained in my experiments in 1851 to 1855, and to measure definitely amounts of pressure.

Q. 285. What was the object of measuring definitely the amounts of pressure at that time?

A. In order to positively determine the safe limits over which it was not advisable to boil wood in the one-stage process.

Q. 286. In conducting your experiments as to how low it was safe to go in boiling wood by the one-stage process, state, as specifically as you can, at what several pressures below sixty pounds you tried experiments at that time, and what were the lengths of time during which those experiments were conducted.

A. To the best of my recollection, I boiled resinous woods to a rough pulp at about fifty-five pounds. The length of time was considerable, but I can't give the exact amount; it might have been from six to nine hours. With non-resinous woods I went, I believe, as low as fifty pounds. I did not go lower in my experiments than fifty-five pounds with resinous and fifty pounds with non-resinous, without pulping wood. I cannot remember the length of time the non-resinous wood was under treatment at a pressure of fifty pounds.

Q. 287. What is the longest period to which you have exposed wood, and what the highest strength of alkali at or below fifty pounds pressure, and failed to produce a pulp by the one-stage process?

A. I cannot answer that question on account of want of recollection.

Q. 288. What is the lowest pressure at which you got a good practical result in making white paper suitable for regular opera-
239 tions from resinous woods? I mean by the one-stage process of boiling in caustic alkali.

A. A good pulp from resinous woods was produced, in 1856, at a pressure of 120 pounds. I understand you to inquire of me the lowest practical pressure, and the ordinary strength of alkali.

Q. 289. And what as to non-resinous?

A. The pulp was produced in the same year by myself, from non-resinous woods, at a pressure of one hundred and ten, or thereabouts. The woods, in my last two answers, were in a favorable condition for working, being comparatively young.

Q. 290. Please state what has been the average pressure used by you for obtaining good practical pulp from resinous and from non-resinous woods?

A. For resinous woods, about one hundred and fifty pounds; for non-resinous, about one hundred and thirty to one hundred and forty.

Q. 291. Was the bulk of your answer to the fourth question in chief written out in advance and read?

A. The bulk of it was.

Q. 292. Was not that or some portion of it read to counsel?

A. It was read to the counsel for the plaintiff after I had written it.

Q. 293. Do the same remarks apply to the seventh, eighth, and ninth answers in your examination-in-chief?

A. I am not positive they were not.

Q. 294. Does the statement of the hydrometic strength of alkali in the solution convey snfficient information to enable a person to perform the process of pulping wood, unless some indicator of the quantity of the liquid in proportion to the quantity of material to be treated be given?

A. No, it does not.

Q. 295. Why not?

A. Because it does not give the absolute amount of soda. The soda has to do a certain amount of work, and, unless you give the amount of gallons, it will furnish no information as to the amount of soda to be used.

Adjourned to October 26th, 1866.

240 OCTOBER 26TH.

Present: Counsel for respective parties.

Mr. Burgess re-examined.

By Mr. Wallace:

Q. 1. When did you first produce pulp by boiling in alkaline solution, at a high degree of temperature?

A. In 1851.

Q. 2. When was the discovery that pulp could be produced by boiling wood in alkaline solution, under pressure, complete?

(Objected to by Mr. Harding,)

A. In the spring or summer of 1851.

Q. 3. Look at your answer to the sixtieth cross-interrogatory, and explain what you have there stated, as to the time occupied in that operation.

A. To the best of my belief, that experiment only occupied the time mentioned.

Q. 4. State why you gave a more particular description of what the defendant's counsel calls the tri-stage process, as applicable to resinous woods than of the one-stage process in your last reissue.

(Objected to by Mr. Harding, because the witness has not given any description of the one-stage process as applicable to resinous woods.)

A. Because the description is very simple in itself and requires no explanation, while the tri-stage process requires a fuller description in order to make it understood so as to enable a person to work it.

Recross-examined.

By Mr. Harding:

Q. 1. Please state at what degree of temperature you produced pulp in 1851, and how you measured the temperature at the time?

A. I did not measure the temperature in 1851, as I had not the means for so doing.

Q. 2. When did you first produce pulp, and measure the temperature at the time you produced it, by boiling in alkaline solution?

A. In 1856.

241 Q. 3. How did you measure the temperature then?

A, By means of tables calculated from steam pressures.

Q. 4. Question repeated, and a fuller answer requested.

A. I measured the pressures by a steam-gauge and calculated temperatures by tables from the pressure.

Q. 5. Have you ever verified, yourself, by any experiment the pressure due to a temperature of 300° Fahrenheit? if so, when?

A. I did, I believe, in 1857 or 1858.

Q. 6. Did you find it to correspond with the tables?

A. I cannot recollect whether in that experiment I did so or not.

Q. 7. When did you first satisfy yourself what pressure corresponds with 300° Fahrenheit?

A. I believe in 1864 or 1865.

Q. 8. What pressure did you then find it to be?

A. In that experiment I took the temperature of alkaline solutions and not of water, and I have not with me my tables for the corresponding temperature of the steam to sixty pounds pressure.

Q. 9. What is the pressure on the steam-guage which you then found to correspond with a temperature of 300° of the alkaline solution?

A. With an alkaline solution of 5 Beaume; its temperature was 300° at fifty pounds pressure.

Q. 10. How did this correspond with the pressure due to 300° Fahrenheit, which you had found in 1858 from the tables?

A. Those tables only refer to the temperature of steam, and not to the temperature of a liquid producing the steam. I do not recollect how they corresponded.

Q. 11. Can you not tell me what pressure you understood as corresponding to temperature of 300° Fahrenheit in 1858?

A. The various tables I had at that time at my command varied considerably, and the experiment referred to as having been made in 1857 or 1858, was to endeavor to ascertain which was the correct table, but I do not remember the exact results of my experiment.

Q. 12. Then you do not now remember what pressure you
242 understood in 1858, as the proper pressure corresponding to 300° Fahrenheit.

A. In 1858, to the best of my recollection, I believe that a pressure of sixty pounds represented somewhere about a temperature of 300° degrees and over of the steam.

Q. 13. Have you ever in practice, or in your experiments, carried on the pulping operation by a thermometric gauge, instead of a pressure gauge?

A. No; I have not.

Q. 14. Why not?

A. Because I had not the appliances.

Q. 15. Which is the most convenient mode of carrying on the process, by the thermometric or the pressure gauge?

A. The most convenient is by the pressure gauge.

Q. 16. If, then, the pressure gauge is the most convenient mode of carrying on the operation, and is the one that you adopted, and if the tables for converting pressures into temperatures are so uncertain that you had to make experiments to try which were correct, will you please state why you set out in the specification which you drafted for the last reissue, thermometric gauge, and omitted wholly the pressure gauges in carrying on the operation of pulping.

(Question objected to by Mr. Wallace.)

A. The reason why the temperature is referred to and not the pressures, is, on account of the uncertainty that existed as to the true temperature as represented by the pressure gauge, and therefore the pressure gauge does not correctly represent the temperatures of solutions of varying strength.

Q. 17. If a person wished then to work your process, as described in your reissued specification, it would be necessary for him to experiment first and ascertain what degree of pressure corresponded with 300° of temperature, would it not, provided he wished to carry on the process as you have always carried it on by a pressure gauge?

A. As it is the fact that the temperature of the solution of caustic alkali effects the purpose sought, namely, pulping wood, and the lowest temperature at which this process can be fairly performed is about 300°, it would be necessary for a person working the process
to ascertain about what would be the corresponding steam
243 pressure by the tables of steam pressures and temperatures

Q. 18. (Question repeated.)

A. No; it would not be necessary to experiment first, as he could obtain the necessary degree of pressure corresponding to 300° of pressure from the ordinary published tables.

Q. 19. If, then, it is only necessary to refer to the ordinary tables

to ascertain what pressure corresponds to 300° of temperature, as you have said, why did you not set out in your specification the pressures themselves at which the operation was to be carried on, and not the temperatures? Why did not you refer to the tables and set out working pressures instead of temparatures?

A. Because the pressures themselves do not give the temparatures of the various strengths of alkili; but it is the best method to calculate about what such temparatures would be, and we therefore used in the patent the words "at, near, or above" the designated temperature.

Q. 20. Have you ever ascertained by experiment what pressure corresponds to 300° of temperature of solution of 12° English and what to 17° English?

A. I have.

Q. 21. When did you do it?

A. In 1865 and 1866.

Q. 22. What are those pressures?

A. I have not my tables with me.

Q. 23. Did you ever ascertain by experiment what pressure corresponds to 500° F.?

A. I do not remember to have done so.

Q. 24. What is the highest point of temperature to which you carried your pressure experiment?

A. To the best of my recollection, to 400° F.; perhaps to 430°.

Q. 25. What pressure corresponds to 430° F. with 12° of English of solution, and also with 17° of English of solution?

A. I do not remember making the experiment with 12° English hydrometer, but with 17° hydrometer; they were about 200 pounds.

Q. 26. You have said that the tables varied so much that you tried experiments to verify them. In what books would a
244 person carrying on paper-making find tables which he could safely use?

A. A person intending to make paper from wood pulp, which is a matter of temperatures and pressures, would have to provide himself with the necessary books if he wanted to obtain nearly the exact corresponding temperatures and steam pressures; great exactness is not essential. Pressures of steam and corresponding temperatures are published in nearly every elementary work on chemistry or engineering, such as Byrnes' Pocket Companion, published in New York by De Witt & Davenport, in 1855.

Q. 27. Can you name any other book specifically where you know such a table could be found?

A. I do not remember the names of any.

Q. 28. What practical difficulty was there in saying that the process could be carried on successfully at a pressure from 110 to 180, and that a good average pressure was 160 pounds?

(Question objected to by Mr. Wallace.)

A. Because it is not so correct a mode as describing the temperature of the solution by which the pulping is effected.

Q. 29. Would not such a description as contained in my last ques-

tion have enabled a person to carry on the process more successfully than to tell him the temparature of the solution was at, near, or above 300°, and that he could go to his books to find out what that meant in pressures?

(Question objected to by Mr. Wallace.)

A. A person could have, no doubt, carried on the process as successfully, but not more successfully, if pressures from 110 to 180 were given; but in drawing up the specification of a patent, it is necessary to give as correctly as possible the means by which the patented process is to be operated, and this is best effected by giving the temperatures of the solution which performs the chemical action.

Q. 30. Have you ever known the process to be operated practically by temperatures as distinguished from pressures?

A. No; I have not.

Q. 31. If your discovery that pulp could be produced by boiling wood in alkaline solution by pressure alone, as a single stage process, was complete in the spring or summer of 1852, why did you not
245 set it out in your specification of August 14, 1853, instead of setting out the hot water, sulphurous acid, and warm alkali process?

A. Because at that time I did not think the producing pulp by boiling wood in caustic alkali would give satisfactory pecuniary results, but in the sulphurous acid and chlorine process, I thought would pay.

Q. 32. When and how did you satisfy yourself first that boiling in a solution of caustic alkali under pressure alone, as a one-stage process, would pay?

A. In the end of 1854 or beginning of 1855, by ascertaining that the recovery of alkali could be successfully carried out by experiment.

Q. 33. Do you believe that that process can now be successfully carried out without the recovery of the alkali? I mean the one-stage process by boiling in caustic alkali.

A. No; if the caustic alkali is neutralized in the pulping of the wood.

Q. 34. How, then, do you understand that the defendants carry on the one-stage process of boiling wood in caustic alkali, as you aware they do not recover the alkali?

(Question objected to by Mr. Wallace.)

A. Because they use an excess of alkali over what is necessary to pulp wood, and then employ this excess mixed with a fresh solution of caustic soda for pulping straw.

Q. 35. When did you first get recovery apparatus into practical operation?

(Objected to by Mr. Jenckes, and witness advised by Mr. Jenckes that he is not obliged to answer that question. Then witness then says, "Then I do not answer that question."

Witness re-examined.

By Mr. Wallace:

Q. 1. Are you acquainted with the different kind of steam-gauges in use, and how much have you known them to differ?

A. I am acquainted with most of the steam-gauges in practical use, and have known them frequently to differ at all rates up to fifty pounds.

Recross-examined.

By Mr. Harding:

Q. 1. What gauge have you adopted as one sufficiently reliable to enable you to carry on your operations in practice?

246 A. We have had great difficulty in obtaining such a gauge, frequently having to send the gauges down to the manufacturers to be tested and repaired. Some gauges have not recorded correctly more than two weeks. The gauge that we have adopted latterly has been Bellfield's, which is perhaps the most correct.

Q. 2. Suppose you were now to instruct a person how to carry on the process of making pulp out of wood in practice, what would you say to him as to gauges?

A. I should advise him to have two gauges to a boiler, one of which to be kept in repair while the other was in daily operation.

Q. 3. What was your practice from 1855 to 1863 in carrying on your operations in practice, as far as relates to gauges?

A. We used, on the slightest suspicion of the gauge being incorrect, to return it to the maker for repairs; and in the later part of the time referred to we were accustomed to have one or more extra gauges. I cannot at the present time call to memory the name of the maker of the gauge we first used, but it was a New York maker.

Q. 4. Is not the mercury column gauge, when well made, a sufficiently reliable gauge for practical purposes?

A. It is.

Q. 5. In speaking of the other gauges do you not allude chiefly to spring gauges?

A. Yes; only to spring gauges.

Q. 6. Is it not your practice to keep a standard mercury gauge and verify your spring gauges by it?

A. It has been for the last few months.

Q. 7. Are not experiments, as a general thing, carried on by the mercury column gauge?

A. Not, to my knowledge, until quite lately.

HUGH BURGESS.

Sworn to and subscribed before me this 26th day of October, A. D. 1866.

CHARLES SERGEANT,
U. S. Commissioner.

247 *Examination-in-chief of Morris L. Keen.*

By Mr. Wallace:

Q. 1. What is your name, age, residence, and occupation?

A. Morris L. Keen; forty-six years of age; I reside in Montgomery county, Pennsylvania; am a wood pulp and paper manufacturer.

Q. 2. Have you been associated with Hugh Burgess in introducing and working the invention of Watt & Burgess for making paper pulp from wood? and if so, state how long you have been associated with him, and when and where the association began.

A. I have been so associated with Hugh Burgess since 1854; first became acquainted with him on his arrival from England.

Q. 3. Describe the kind of vessel used in working said invention, the kind of liquid employed, and the strength of the same, and also the pressure and temperature required; and state whether paper pulp was produced by such process.

A. The kind of vessel employed was a rotary boiler about 8 or 10 feet long, 3 feet in diameter, made at the suggestion of Hugh Burgess to stand a working pressure of 200 pounds to the square inch. The kind of liquid employed was caustic alkali in solution of a strength from 10° to 12° Beaume; the pressures under which such boiler was worked was carried from 100 to 120 pounds, with a safety-valve weighted to represent those pressures. We had no steam-guages; and paper pulp of an ivory class was produced by such boilers, which was afterwards made into white paper.

Q. 4. State whether pulp was produced by the process described before it was subjected to the treatment of chlorine, as described in the specification of the original Watt and Burgess patent.

A. An ordinary pulp was produced, but it was subjected to the treatment of chlorine, as described in the specification of the original Watt and Burgess patent. The woods employed at that time were of a resinous character.

Q. 5. State what was the action of chlorine on the pulp produced by boiling in alkaline solutions under pressure.

A. The action of the chlorine was to remove such inter-
248 stitial and resinous matter as was not previously removed by the boiling of the wood in alkali.

Q. 6. State whether or not you have continued to work the invention of Watt and Burgess since 1854; and if so, when, and to what extent?

A. I have continued to work the process in connection and association with Hugh Burgess since that time, at Royer's Ford, and continued to work it up to this time; likewise have constructed and arranged the wood pulp works of the American Wood Paper Company, at Manayunk. The extent has now grown to the production of fifteen to eighteen tons a day in both mills.

Cross-examined.

By Mr. Harding:

Q. 1. Who else was associated with you at Gray's Ferry, in 1854?
A. F. B. Houghton.
Q. 2. In what way?
A. Mr. Burgess, I understood, sold Mr. Houghton the patent. I knew nothing about the arrangement between Mr. Burgess and Mr. Houghton.
Q. 3. When did Mr. Burgess acquire his interest as a copartner with you?
A. At the time of the transfer to the American Wood Paper Company.
Q. 4. What was the agreement between you and Mr. Burgess prior to that time?
A. I had no agreement with Mr. Burgess prior to that time.
Q. 5. State precisely what relations Hugh Burgess occupied to you from 1854 down to the time you sold out to the American Wood Pulp Company, and in what way was he associated with you?
A. He was induced by Mr. Ladd and myself to remain, and develop or work out the process originating with himself, with an understanding that when the process was fully developed and a paying institution, that a pecuniary interest should be awarded him.
Q. 6. When was it that this inducement was held out?
(Objected to by Mr. Wallace.)
249 A. After Mr. Ladd and myself got control of the patent in this country, in 1855, I think.
Q. 7. What interest was it understood he should receive if he would remain and develop the invention?
(Objected to by Mr. Wallace.)
A. There was no defined amount or interest ever mentioned. It was left to Mr. Ladd and myself to tender him what we thought was right.
Q. 8. What portion of the profits, if any, did he receive prior to the sale to the American Wood Pulp Company?
(Objected to by Mr. Wallace.)
A. He had no interest in the profits.
Q. 9. Did he receive any of the profit?
(Objected to by Mr. Wallace.)
A. He did not.
Q. 10. Did he receive remuneration for his services in any way?
(Objected to by Mr. Wallace.)
A. His current expenses were met by the institution.
Q. 11. In what capacity did you and Mr. Ladd regard him? as an employee or not?
(Objected to by Mr. Wallace.)
A. We did not regard him as an employee. His position was in no way defined further than stated.
Q. 12. What were his duties?
(Objected to by Mr. Wallace.)

A. His duties were making and conducting various experiments, and giving general instruction to carry out his patent in the manufacture of wood paper pulp.

Q. 13. State more precisely what was the object of these experiments.

(Objected to by Mr. Wallace.)

A. To become familiar with all the details and possible manipulations connected with the invention.

Q. 14. When, if ever, was it that he succeeded in developing and working out the process, and making it a paying institution?

(Objected to by Mr. Wallace.)

A. It is difficult for me to define the exact time when the institution became a paying institution.

250 Q. 15. State as near as you can.

(Objected to by Mr. Wallace.)

A. I would say the institution fluctuated with the prosperity of all paper makers; there were a great many ups and downs in it.

Q. 16. How was it in 1859?

(Objected to by Mr. Wallace.)

A. My memory does not serve me exactly; without reference to our books I am not prepared to answer any questions on dates.

Q. 17. State as near as you can when the institution became a paying institution.

(Objected to by Mr. Wallace.)

A. There was money made in 1856, but expended in the extension and alteration in our works; after 1856, all money that was made, if any, was expended in increasing and developing our works.

Q. 18. Who owned the works at Royer's Ford?

A. J. and D. George the real estate and a portion of the machinery.

(This question is objected to by Mr. Wallace.)

Q. 19. Who carried on the business, and what was the arrangement with J. and E. George?

(Objected to by Mr. Wallace.)

A. Ladd & Co. carried on the business. What arrangement Mr. William F. Ladd had especially with the Messrs. George I have no knowledge of.

Q. 20. Were you a partner of Ladd?

(Objected to by Mr. Wallace.)

A. I was interested with him.

Q. 20. Who composed the firm of Ladd & Co.?

(Objected to by Mr. Wallace.)

A. Transactions were always made in William F. Ladd's individual account.

Q. 22. Then you understand he was carrying on the business at Royer's Ford as an individual, under the title of Ladd & Co.? Is that so?

(Objected to by Mr. Wallace.)

A. William F. Ladd furnished the means and conducted the

business as the principal and capitalist of the institution.
251 My interest was an equal interest in the profits of the concern, if it proved profitable.

Q. 23. Did you receive a salary in addition? and if so, in what capacity?

(Objected to by Mr. Wallace.)

A. I did not.

Q. 24. Did the firm pay a rent to the Georges?

(Objected to by Mr. Wallace.)

A. The lease of the mill was made through Mr. William F. Ladd. I am not aware of the conditions of the arrangement. All business connected with the Messrs. George was privately arranged between them and Mr. Ladd.

Q. 25. Did the Messrs. George furnish money for construction account?

(Objected to by Mr. Wallace.)

A. They furnished Mr. Ladd funds; on what conditions I am not aware.

Q. 26. Who paid for the four upright boilers constructed by Stanhope & Supplee, and erected at Royer's Ford, in August, 1859?

(Objected to by Mr. Wallace.)

A. Messrs. George settled that account with Stanhope & Supplee, by furnishing the funds by some special arrangement with William F. Ladd. I know nothing of the arrangement.

Q. 27. Were those boilers like the boiler shown in Exhibit N. I. ?

A. Yes; with the exception of two of the four were furnished with bottom conical screens.

Q. 28. Are those four boilers in use now?

A. Yes.

Q. 29. Whose property are they now?

A. The American Wood Paper Company's.

Q. 30. When and from whom did they acquire them?

A. They acquired them in the transfer of our effects, or from a sale of the mill property by the Messrs. George. The time I cannot say.

Q. 31. How long did the firm of Ladd & Co. carry on business at Royer's Ford?

(Objected to by Mr. Wallace.)

252 A. From 1855 or 1856 to 1859 or 1860. About the time Samuel Walsh took possession of the mill.

Q. 32. Did Samuel Walsh carry on the business at the mill from the time Ladd & Co. stopped in 1859 or 1860, until the sale to the American Wood Paper Company?

A. Samuel A. Walsh carried on the business in his individual name for the interest of Mr. Wm. F. Ladd, myself and himself.

Q. 33. Did he carry on the process of making pulp from wood to any extent at Royer's Ford?

(Objected to, as well as the last question, by Mr. Wallace.)

A. To the extent of from 9 to 12 tons per week, during that period, as near as I can recollect.

Q. 34. Was all the wood that was pulped during that time pulped in the four upright boilers which had been erected in 1859?

(Objected to by Mr. Wallace.)

A. It was.

Q. 35. From whom did the American Wood Company purchase the effects, and at about what time?

(Objected to by Mr. Wallace.)

A. It is difficult for me to answer that question; the transfer was made of the patent rights by Ladd and myself through negotiations made by sundry parties, Walsh, Ladd, and a man named Carson. I cannot define exactly who made the final agreement; I think it was brought about through Mr. Ladd.

Q. 36. What ownership had you individually in any effects but the patent?

(Objected to by Mr. Wallace.)

A. The ownership I held was in some property formerly at Gray's Ferry, the rotary boiler, shafting, pans, &c. That is all the interest I had in any property at Royer's Ford.

Q. 37. Have you ever examined the provisional specification of Watt & Burgess of August 14, 1853?

(Objected to by Mr. Wallace.)

A. I have never examined that specification or a copy of it.

Q. 38. Did you ever examine the English specification of February 18, 1854?

(Objected to by Mr. Wallace.)

253 A. I don't think I ever examined that or a copy of it.

Q. 39. Were you consulted at the time of the purchase of the Mellier patent by the American Wood Paper Company?

(Objected to by Mr. Wallace.)

A. It was talked about; I don't know that I was consulted, as the business was put in the hands of Walsh, Ladd & Carson, to negotiate with the Wood Paper Company, on the best terms they could obtain.

Q. 40. Do you know what was the object of the American Wood Paper Company in purchasing that patent?

(Objected to by Mr. Wallace.)

A. The object was to complete the sale and transfer in a satisfactory manner to the American Wood Paper Company of our patents. The American Wood Paper Company asked of us to transfer the Mellier patent, at the same time we transferred our patent.

Q. 41. Did you understand that the last re-issue of the Watt & Burgess patent covered the working of straw under pressure in alkali?

(Objected to by Mr. Wallace.)

A. I did.

Q. 42. Can you give any explanation then why the Mellier patent was purchased?

(Objected to by Mr. Wallace.)

A. Nothing more than stated in my previous answer.

Q. 43. What is your interest in the American Wood Paper Company?

(Objected to by Mr. Wallace, and the witness advised that he may decline answering the question if he has personal reasons for so doing.

A. I decline answering. I am a considerable stockholder.

Q. 44. What office do you hold under the company? and what is your salary?

A. I am an engineer of the company; my salary is $5,000.

Q. 45. What is the lowest pressure at which you have carried on pulping for wood successfully at those works since you have been connected with them? and what is your usual pressure in working?

(Objected to by Mr. Wallace.)

254 A. I generally work from 140 to 160 pounds; gave no instructions to work below 140, considering that a safe pressure for working at; that is the pressure we work all kinds of wood at; I have never worked at any less than that. I never carried it to a minimum. I have carried it as high as 220; that is the highest.

MORRIS L. KEEN.

Sworn and subscribed before me this 26th day of October, A. D. 1866.

CHARLES SERGEANT,
Commissioner.

JUNE 7, 1867.

Present, Messrs. Wallace and Harding.

B. Howard Rand re-called:

Q. 1. In your answer to interrogatory 17 you say that "when a vegetable substance is incompletely pulped, that is, when the whole of the intercellulose is removed, very slight mechanical action is sufficient to separate the already isolated fibres." What is meant by "very slight mechanical action?"

A. When wood pulp is blown from the boilers the form of the chips is entirely lost. The specimen which I present, (marked Exhibit H. B. R., No. 39, C. S., Examiner, &c.,) was obtained by me from the plaintiffs' works at Manayunk. It is pulp after it has been blown from the boiler and washed by a stream of water from a hose. When the pulp is drawn from the boiler it retains the form of the chips, but falls to pieces by the action of the stream of water used in washing, and may be crushed between the finger and thumb. The specimens of pulp submitted with the table, Exhibit B, were thus prepared.

Q. 2. In your answer of cross-interrogatory 5 you state that the pulp, after having been washed, is passed through a rag-engine. What is the object of this operation?

A. It is to mix the pulp with water to such a consistence as to enable it to be pumped into a tank. At Royer's Ford the rag-engine is not used, but the pulp is mixed by means of a wooden

255 dasher. The beating after bleaching is to enable the fibres to felt, and is necessary in pulp of all kinds, whether made from wood, rags, or other material.

Q. 3. Have you made an experiment with broom?

A. Yes. I boiled half an ounce of the woody part of broom with twenty fluid ounces of a solution of caustic soda at 9° B., for two hours, at a pressure of about 45 pounds. It was softened, but not disintegrated. I submit a specimen of the product. The proportion of alkali to wood in this case was 200 per cent., being ten times that required to pulp poplar wood at the proper temperature, and for twice the length of time necessary in the same experimental boiler.

Cross-examined:

By Mr. Harding.

Q. 1. Do I understand you to intend to convey the impression by your examination-in-chief to-day, that in working under the reissued patent of Ladd & Keen, of 1863, the use of a rag-engine would in no way aid or contribute materially to the production of the pulp?

A. I do so intend. The use of the rag-engine is necessary after the pulp is bleached, before it can be made into paper.

Q. 2. Do you not believe that some mechanical means of crushing or separating the wood into shavings or chips, or shreds, is important before or during the time of its being treated by chemicals, to make pulp? or could the pulp be as well made by submitting the logs to chemical treatment?

A. The subdivision of the wood is important, as it facilitates the action of the alkali and shortens the time of the process.

Q. 3. Have you ever treated wood, or seen it treated, chemically, without some previous disintegration, such as chipping, crushing, or grinding?

A. I have not.

Q. 4. Is the specimen, Exhibit No. 39, which you now produce, a fair specimen of the unbleached pulp which you understand to be produced by the Ladd & Keen reissued patent 1,448 and 1,449, as the result of the first stage of treatment?

A. It is.

Q. 5. In giving your answers as to the Watt and Burgess invention, patented in said reissue, have you considered it to be a process which produces a result such as Exhibit 39, by a single treatment in caustic alkali under pressure?

A. I have.

256 Q. 6. Under what pressure and corresponding temperature was that result, Exhibit 39, produced?

A. I did not notice the pressure on my visit to the works that day. I suppose it was produced at 150 pounds pressure, corresponding to a temperature 378° Fahrenheit.

Q. 7. Have you any practical knowledge or experience on the subject of paper-making, other than that derived from your visits to the plaintiff's works? and if so, what?

A. I have no other, except in so far as in my experiments in making pulps, as here testified to.

Q. 8. How many visits have you made to the plaintiff's works

prior to giving your first testimony-in-chief, and how long a time did you spend there?

A. I think five visits; I generally spent half a day, or nearly that; on one occasion nearly the whole day.

Q. 9. When you say a certain mechanical treatment of fibres is necessary to enable them to felt in pulp of all kinds, do you state what was stated to you by others, or do you state the result of your own experiments? and if so, what experiments?

A. I state on information received at the works from Mr. Nixon. I think also from Mr. Burgess. I do not now remember any others.

Q. 10. To what mechanical treatment did you submit the broom, referred to in your experiment, preparatory to boiling it in caustic alkali?

A. I took off the bark and cut the wood into short pieces; that was all the mechanical treatment it underwent; the pieces were about an inch long.

Q. 11. In your experiment, as detailed, in your third answer in your examination-in chief to-day, do you consider that you worked under the Watt and Burgess patent, as reissued, 1,448 and 1,449?

A. I do, inasmuch as the temperature was about 300°, and a solution of caustic alkali of a strength of 9° Beaumé was employed.

Q. 12. What was your object in making that experiment? Why did you select 9 degrees Beaume as the density of your solution, and forty-five pounds as your pressure?

257 A. From my cross-examination, I presumed that it would be assumed that the patent of Sieur Gros called for such a strength of alkali, and such a pressure, and I wished to see if, allowing such assumption, broom could be pulped.

Q. 13. Do you know what was the age of the broom that you used?

A. I do not.

Q. 14. Have you ever seen broom grown before?

A. I have seen broom growing, but I did not see this growing. I saw it growing several years ago in considerable quantities in what is now Fairmount Park.

Q. 15. What was the temperature attained in that experiment made by you with the broom, and of which Exhibit 40 is the result?

A. About 300° Fahrenheit.

Q. 16. If in making that experiment you consider you worked under the Watt and Burgess patent, reissue 1,449, do you, or do you not, consider Exhibit 40 as a result produced by the Watt and Burgess process?

(Mr. Wallace objects to the question.)

A. I do not; for this reason: In acting upon a wood of the tough character of broom for the purpose of disintegration, under the Watt and Burgess patent, I certainly should have used a higher pressure and corresponding temperature, being satisfied, from previous experiments, that a satisfactory result could not be obtained in acting upon such material at a pressure of about forty-five pounds and temperature of 300° Fahrenheit. I did not make that experiment under the Watt and Burgess patent.

Q. 17. What temperature would you have used in treating broom, if you had intended to work under the Watt and Burgess patent, reissue No. 1,448 and 1,449?

A. About 380° temperature, corresponding nearly to a pressure of one hundred and sixty pounds.

Q. 18. In making the experiment, Exhibit B. H. R., No. 7, boiling wood in 318° Fahrenheit, in caustic alkali, do you consider you worked under the Watt and Burgess patent, as reissued, No. 1,448 and 1,449?

(Question objected to.)

A. I do.

258 Q. 19. Is the result shown in Exhibit 7 a specimen of the result of the Watt and Burgess patent, as reissued, No. 1,448 and 1,449 or not?

A. It is not, for the reasons given in my last answer in reference to Exhibit 40. If I had desired to make paper pulp from the wood, such as I was experimenting on, I would have used higher temperature and corresponding pressure. The experiment was not made for the purpose of producing pulp for the manufacture of paper, but to compare the effects of caustic alkali upon wood at different pressures and temperatures.

Q. 20. What wood did you employ in that experiment, Exhibit No. 7? and how high a temperature would you have employed, had you desired to work under the reissue of the Watt and Burgess patent, Nos. 1,448 and 1,449?

(Question objected to.)

A. I employed poplar wood; and if I had desired to work under the reissue of the Watt and Burgess patent, Nos. 1448 and 1449, I should have used a pressure of 160 pounds, corresponding to a temperature of about 376° Fahrenheit.

Q. 21. Can you name to me any specific wood with which you would have used a temperature of 300° Fahrenheit, if you had desired to work under the Watt and Burgess patent, as reissued, Nos. 1,448 and 1,449, and a corresponding pressure?

(Question objected to.)

A. I have experimented with but four varieties of wood, commonly so called, pine, poplar, bamboo, and broom. I have succeeded in disintegrating bamboo at that temperature, but should not practically employ it, for the process is shortened and the product improved by using the higher temperature. I cannot name any specific wood with which I would use the above temperature.

Q. 22. Can you quote any part of the Watt and Burgess patent, as reissued, Nos. 1,448 and 1,449, which conveys the information that a temperature of 360° Fahrenheit and the corresponding pressure is the proper one for treating wood of any kind, or a temperature of 300° Fahrenheit is too low a temperature for certain woods?

(Question objected to.)

A. I cannot make such quotation.

259 Q. 23. Are there not vegetable materials which, in your judgment, would be completely pulped at a pressure due to 212° Fahrenheit in caustic alkali?

A. Yes.

Q. 24. Please furnish me the equivalent of Beaume's hydrometer and the English hydrometer of from 1 to 25.

A.

Comparison of the Hydrometers of Twaddell and Beaume.

B.	Tw.	Tw.	B.
1° =	0.14°	1	—
2 =	3	2	1½
3 =	4	3	2
4 =	5.5	4	3
5 =	7	5	4
6 =	8	6	4½
7 =	9.6	7	5
8 =	11	8	6
9 =	12.6	9	6½
10 =	14	10	7¼
11 =	15.6	11	8
12 =	17	12	8½
13 =	19	13	9¼
14 =	20	14	10
15 =	21.8	15	10
16 =	23.6	16	11¼
17 =	25.2	17	12½
18 =	26.1	18	12½
19 =	28.1	19	13
20 =	30.4	20	14

Q. 25. What is the pressure due to a temperature of 500° Fahrenheit?

A. About 662 pounds total internal pressure, equal to 647 pounds pressure of the steam-guage.

Q. 26. In working at a temperature of 360° as a practical temperature for securing the result of Watt and Burgess patent, reissue Nos. 1,448 and 1,449, with the ordinary woods, such as pine, poplar, fir, do you arrive at that temperature as the result of experiments made by you, or from any specific statement of temperature
260 made in the reissued patent of Watt and Burgess, Nos. 1,448 and 1,449? and if from any specific statement of temperature therein, quote that statement.

(Question objected to.)

A. I arrive at that temperature from my experiments, and not from any statement in Watt and Burgess patent, as reissued, Nos. 1,448 and 1,449.

Q. 27. Do you consider time an important element in treating wood with caustic alkali under pressure to make pulp?

A. I do. As you diminish the pressure to a certain point you can make up for it by lengthening the time of boiling. Again, when the wood is in large chips a longer time is requisite than when it is broken in small pieces. Less time also is required in a small than a large boiler, when treating a small quantity.

Q. 28. Do you consider the quantity of alkali to the weight of wood to be important?

A. Yes I do.

Q. 29. Can you quote anything from the Watt and Burgess patent, as reissued, Nos. 1,448 and 1,449, which indicates the proportion of alkali to the weight of wood, or which indicates the time of the operation?

A. There is no definite indication of the per cent. of alkali to the weight of wood. If, however, a solution of caustic alkali of 17 Twaddell, sufficient to cover the wood, be employed, it would give a slight excess of alkali under ordinary circumstances. There is a direction as to time, I believe, viz, from four to twelve hours.

Q. 30. Will the same amount of water, at 8½ Beaume, answer with resinous woods?

A. I should suppose that it would. I cannot say of my own knowledge. I never made any experiment or observation on this point.

Q. 31. Can you fix the minimum strength of alkali that can be used, if the water just covered the wood, to produce pulps with the ordinary woods.

A. I cannot.

Q. 32. Does the patent contain any indication of the quantity of the solution of a given strength to be used?

A. It does not.

261 Q. 33. What is the lowest proportion of alkali to the wood, treated by weight, that you have succeeded in making pulp of in your experiments?

(Objected to.)

A. Eighteen per cent. of the wood treated, by weight; an imperfect pulp, but one that would bleach was made with 44.4 per cent. of caustic alkali.

Dr. Rand re-examined.

By Mr. Wallace:

Q. 1. The intercellulose being removed by oxidization in this process of pulping wood, is there not an equivalent of alkali that is necessary to the perfection of the operation, without reference to particular temperatures or strength?

A. A certain percentage of alkali is requisite. I believe that the intercellular matter is converted into organic acids, probably ulmic, humic, and geic acids. These form a definite chemical compound with the soda. When the alkali is deficient in quantity—as in experiments 4 and 5 of the table—all the intercellulose is not removed.

Q. 2. That being the state of the case, would not the commercial success of the process render it necessary or desirable for the manufacture of pulp to approach as near possible to the exact equivalent in practice, and would not the profit of the manufacture greatly depend upon that?

A. Yes; a light excess would do no harm.

Re-cross examined.

Q. 1. Do you not believe that the alkali used under the Watt and Burgess process in treating wood should be recovered by evaporation and incineration, in order to render the Watt and Burgess a practically profitable one?

(Question objected to.)

A. I know nothing of the profits of the operation.

Q. 2. Do you find any statements in the patent which convey the idea that there must be a certain amount of alkali to the weight of wood used, to make it practicable or profitable? and if so, what per centage of alkali is stated to be necessary to make it practicable or profitable?

A. I find no such statement in the patent.

Q. 3. Then your idea is, that a person is to ascertain by ex-
262 periment what amount of alkali is practicable or profitable, and having ascertained that by experiment, is to work according to the experiment?

A. Experiment would be necessary, and the quantity of alkali would have to vary from from day to day with the condition of the wood. In this, as in all other chemical manufactures, the quantity of materials used, and the manipulations must vary from time to time according to the nature of the products.

Q. 4. Then I understand you to say, that if a person were informed that about 18 or 20 per cent. of caustic alkali to the weight of the wood, would answer well in practice, it would not be sufficient instruction to enable him practically to carry on the process, so far as quantity of alkali is concered?

A. I certainly did not intend to convey that impression.

Q. 5. Would not such information, if given, have obviated the necessity of experiment, so far as quantity of alkali is concerned?

A. Not entirely; with the ordinary woods in their ordinary condition it would.

Q. 6. Does the Watt and Burgess patent state any thing as essential, except as to the boiling in a solution of caustic alkali under a pressure at, near, or about 300° Fahrenheit?

(Question objected to.)

A. It gives a certain time and strength of alkali in addition.

Q. What length of time, and what strength of alkali is sufficient?

A. Four hours of time is essential; the strength of alkali given in the patent is from 10 to 17 of the English hydrometer.

Q. 8. Now what would be the effect of boiling the ordinary woods, such as poplar or pine, in caustic alkali of a strength of 10° English hydrometer, and a temperature of 300°, and four hours, based on your experiments?

A. I have no experiment on which to base an opinion. To the best of my belief, from a comparison of my other experiments, I do not think it would be pulped.

Q. 9. Would not the result, in your opinion, be similar to Exhibit No. 11?

263 (Question objected to.)

A. It would, probably.

Q. 10. Would such a result as shown in Exhibit 6 or 11 be, in your opinion, the result contemplated by the Watt and Burgess process?

A. It would not.

Q. 11. Do you consider that in producing those specimens you worked under the Watt and Burgess patent, or not?

(Question objected to.)

A. I do not; for reasons before stated, to-wit: I was not attempting to make a pulp for the purpose of paper manufacture, but was experimenting on the relative effects of different temperatures on the same chemical substances. If I had wished to produce a pulp for paper manufacture under the Watt and Burgess process from the poplar wood on which I was experimenting, I would have used a temperature of say 360° F.

B. HOWARD RAND.

Sworn and subscribed before me this seventh day of June, A. D. 1867.

CARLES SERGEANT, *Commissioner.*

[For fac similies see pages 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274. and 275 of original transcript of record.]

276 In the Circuit Court of the United States for the eastern district of Pennsylvania.

Complainants' testimony.

THE AMERCIAN WOOD PAPER COMPANY *vs.* JACOB D. HEFT *et al.* } April sessions, 1865. No. 21.

Present: H. E. Wallace, esq., for complainants; Geo. Harding, esq., for defendants.

Charles M. Cresson, a witness for complainants, being duly sworn deposeth and saith, as follows:

Q. 1. What is your name, age, residence, and occupation?

277 A. Charles M. Cresson. I am thirty-nine years old; I reside at No. 19 South Sixteenth street, Philadelphia; I am an analytical chemist and chemical expert.

Q. 2. Have you made any examination of the materials in common fuse or papers making, and of their treatment? and if so, can you state the results of your observations as to the requisites for a good paper pulp.

A. I have examined many materials in use for the manufacture of paper pulp, and have observed their behaviour, wet and dry, under the microscope, and made comparison of their elasticity, strength, and flexibility.

Flax, cotton, and the fibres of straw, and those from the body or true wood of trees are the most common and important.

Flax is the filamentous bark of the Linum Usitatissimum, separated from the woody part (which is rejected) by a process of rotting, by which the gummy and resinous matters are partially removed, an operation requiring from ten to forty days careful manipulation, and an after oxidizing treatment to cleanse the fibres from adherent glutinous matters.

The fibre from flax is very strong, and is able to endure the severe beating processes which are necessary to make it properly flexible for paper pulp, and it becomes so flexible that it will mat or intertwine and form a strong paper, notwithstanding the short lengths into which the fibres are reduced in the beating engine.

The average length of flax fibre obtainable from fine paper is much exceeded by the fibres obtained from the true wood of the tree by other processes. See plate C—1, showing the comparative length of fibres obtained from various sources, and also plate C—9, showing the fibres of flax obtained from Whatman's drawing paper, (magnified 150 diameters or 22,500 times).

Cotton is a filamentous attachment to the fruit of the Gossypium Herbacium. It has a long fibre, which as it dries becomes flattened, and twists upon its axis. See plates C—2 (a), and C—2 (b).
278 From this latter peculiarity, it necessarily forms a loose and spongy paper.

Straw yields a stiff and elastic (nearly round) tubular fiber with pointed ends, and about $\frac{1}{11}$ of an inch in length. See plate C—1, fibre h, and plates C—3 (a), and C—3 (b). It is intermixed with a great variety of short cells of large diameter, and also of smaller fibers. This fiber is very deficient in flexibility.

The fibres of the evergreen coniferous woods, as yellow and white pine, hemlock, &c., in figure, somewhat resemble cotton; they are chiefly long, flat, tape-like, dotted fibres, bending easily in one plane only superior to cotton for the reason that they do not change their diameters greatly, neither do they twist or untwist so much when they are dried or wetted.

Their length, as compared with the fibre obtained from the decidnous woods, straw, and flax from paper, can be observed by an inspection of plate C—1. The fibre "a," from yellow pine was so long as to require it to be cut into two pieces to bring it into the field of the mircoscope.

These fibres are very stiff and inflexible unless beaten. The fibres marked a, a, on plate C—5, showing wood pulp ready beaten for paper are from pine wood. Plate C—10, shows pine fibre in position.

The deciduous woods yield a fibre averaging about $\frac{1}{10}$ of an inch in length, and somewhat over $\frac{1}{1000}$ of an inch in diameter, tubular, and with pointed ends, and if perfectly free from incrust or resinous matters, very flexible, and with but little elasticity, bending easily in every direction, and matting well; but which if coated with intercellular matter becomes very stiff and apt to break when forcibly bent. (See plate C—1; for fibre of poplar d, cherry e, ash f, ebony g; also, plate C—4, (a) showing the cells and fibres of poplar heart,

plate C—4 (b), showing the cells and fibres of poplar sap,
" C—4 (c), " " " hickory "
" C—4 (d), " " " ash "
" C—4 (e), " " " cherry "

all highly magnified and free from incrusting matter, plate C—7 showing poplar with but little of the incrust removed, and plate
279 C—8, showing poplar with a portion of the incrust remaining.

The dotted cells are not very numerous in comparison with the plain fibre, and being of thin tissue easily bend and fill up the texture of the fabric.

The short sections into which the fibres of flax are reduced in the cutting and beating machines whilst undergoing the process designed to give them the necessary flexibility for proper matting or intertwining, show the test of the suitability of other fibres to depend rather upon their flexibility and behavior, under certain hydrometric conditions, than upon their individual length and strength; and render it easy to classify the materials that may be presented for examination, by their behavior and appearance, wet and dry, under the miscroscope.

The action of the beating machine is to crush in the sides of the tubular fibre, so as to destroy its ability to resist a cross strain, and thus render it more flexible and elastic (see plate C—5).

This may be illustrated by rolling up a small cylinder of sized paper; it will, if supported at the ends, carry a considerable weight, but if the sides be crushed, or the paper much rumpled before rolling, it loses its ability to support even its own weight.

The value of the fibres enumerated is much lessened by the presence of any incrusting matter which may thicken their walls, or may unite two or three or more fibres together side by side. (See plate C—8.) The force necessary to bend fibres thus united increases in greater portion than the sum of the forces necessary to bend the same fibres not thus united; thus, for example, we can readily bend several slips of wood as thick as an ordinary lead pencil, but if these be firmly glued together they will successfully resist a considerable addition to the force.

That process which mostly perfectly isolates the fibre must, therefore, be best adapted for preparing the crude material for pulp, and any mode of preparation which simply breaks down the woody structure in mass,—see plates C—6 (a), and C—6 (b)—without reference to the separation of its compotent fibres in detail, must
280 also fail to produce a material which, by itself, without admixture of other fibre, can be employed for the production of paper. Ground wood, kaolin, or clay are frequently mixed with good pulp to increase the body of paper intended to be used for special purposes, and are not necessary for the formation of good merchantable paper, all such additions detracts from the flexibility and strength of the paper.

From a consideration of the above observations, I conclude that the chief requisites for a good paper pulp are fibres possessing great

flexibility, and without a tendency to twist or curl up upon being dried.

Q. 3. Have you examined the Watt & Burgess patent? And if so, state upon what, in your opinion, its efficiency depends, and your reasons for that opinion.

A. To understand properly the process of analytical disintegration made use of in the Watt & Burgess process, to separate the component parts of vegetable matter, so as to obtain the fibres of wood clear of adherent matter, we begin by studying as closely as possible the synthetic formation of vegetable matter, and the materials and forces employed by nature in their production.

Three distinct functions are chiefly engaged in the process of vegetable assimilation and growth, to wit, absorption, circulation, and respiration.

Respiration takes place in the leaves and green parts of the tree, by which function carbonic acid is absorbed from the atmosphere. The plant breaks this gas up into carbon and oxygen, assimilating the carbon, and giving out a portion or the whole of the oxygen during the continuance of light, and reversing this process in a minor degree during the hours of darkness.

This process of deoxidation still takes place, but in a lesser degree, as the sap descends through the green parts and cambium layer. Thus, by the exercise of the functions of absorption, circulation, and respiration, plants, by the elimination of oxygen, break up carbonic acid and water, and form hydrogen, carbon, and oxygen compounds.

These are soluble in proportion as they contain oxygen, and
281 become more difficult to dissolve as they lose oxygen, finally yielding woody fibre, resins, oils, and the like, as the result of deoxidation. To render these again soluble, so as to be useful as new food, the reverse process, or that of oxidation, takes place, and nature finally restores the elements to the state of water and carbonic acid, from which they were originally derived.

The secretions of starch, gum, sugar, &c., are all derivable from the components of the air, carbonic acid and water, and are convertable into each other by varying the amount of the elements of water present, and by oxidation and deoxidation.

In germination, the food provided for the young plant is insoluble starch. This is rendered soluble by the process of oxidation, giving out carbonic acid, which continues until the young plant has risen above the surface of the ground and is able to provide for itself from the carbonic acid of the air and by water absorbed by the root, at which time the process is reversed, and deoxidation commences, and likewise the formation of the woody fibre, starch, sugar, &c.

Cellulose or woody fibre, starch, and dextrine are identical in composition, differing only in the molecular arrangement, which molecular arrangement effects their physical properties and chemical relations in much the same manner as is the case with carbon in its different states of charcoal, coal, plumbago, or the diamond.

To obtain starch in a soluble form, it may be acted upon by oxygen, which, by the elimination of carbon, converts it into sugar, and

nature most frequently stores its excess of food in the form of starch, to be redissolved and again deoxodized and converted into cellular structures.

In the laboratory it may be heated to 300° Ft., which converts it into dextrine, soluble in cold water.

If we add to celloluse or starch the elements of one equivalent of water, we convert them into soluble gum, or into cane sugar; if we add the elements of four equivalents of water, we convert them into grape sugar.

In all chemical processes the manipulations requiring interchange of elements take place with most readiness when the bodies to be operated upon are in an extremely divided state.

282 Thus the tree is able to burn up its carbon at a temperature but little above 32° Ft.; the oxygen of the air in the lungs of an animal seizes upon the carbon at a temperature of about 100° Ft.

Charcoal will ignite at a red heat, say 600° Ft., whilst anthracite requires over 1,000° Ft., and the diamond will not consume under 2,000° Ft.

In the case of the tree and animal the carbon and oxygen are both gaseous. In the other examples the carbon is in the solid form, and is presented to the oxygen in a more compact state.

Ulmic acid is naturally produced in decaying plants by slow oxidation, and under this influence the intercellulose, and finally the woody fibre, are rendered soluble at ordinary temperatures, and this with the addition of but a minute amount of alkali; whilst to do the same work rapidly in the laboratory we require a high temperature and a large amount of alkali, and, to carry the process on for enough to dissolve the whole of the woody fibre, a still farther augmentation of heat and alkali, the cambium or sap layers being first acted on, and ultimately the true (heart) wood.

Experience has taught us the limit to which the process should be carried so as completely to dissolve the intercellular and preserve the fibrous parts.

An examination of the processes of vegetable growth and decay plainly exhibits the fact that, by means of the elimination and absorption of oxygen, organic structures are built up from the elements of the air and of water, and are again restored to their gaseous and liquid form, and also that these processes are materially aided by the presence of the alkalies, and modified by the temperatures to which they are subjected.

In many cases nature makes use of increased temperature to accelerate its operations, and provides special means for protection from too rapid a loss of heat.

For example, in the flowering of certain plants the rapid growth and decay of the flower requires the evolution of a considerable degree of heat, produced by oxidation, and the plant, to prevent the too rapid radiation of this heat, throws out an odor, which

283 Tyndale has shown, greatly retards the radiation of the invisible rays of heat. The thermometer in some cases shows a local rise of several degrees of temperature in the parts of the plant which are undergoing these chemical changes.

In the Watt and Burgess process for obtaining the fibre of wood free from cementing matter, we have a crude copy of the process which nature employs in the separation of vegetable structure into its original components and in rendering them soluble. Experiment has taught us that we may accelerate the slower natural action, and yet restrain it at such a point as may be desirable, by the application of a certain degree of heat and proportion of alkali, and render soluble only those cementing tissues which are more highly oxygenized than the fibrous parts which we desire to preserve. From experiment we also learn that, to do this work, we must employ a certain degree of heat and percentage of alkali, to compensate for the different molecular condition in which we present the elements to each other for action and reaction, just as we have seen that the temperature at which carbon and oxygen unite and form carbonic acid varies in proportion to the fineness of the molecules presented for combination.

I find that the vegetable fibres of all the varieties of heart wood that I have experimented upon can be thoroughly separated from the intercellulose by exposure to a temperature of over 320° Ft. in an alkaline bath containing of caustic alkali between 16 and 50 per cent. of the weight of the wood. The sap wood begins to disintegrate at about 300° Ft. Also, that as the fibre bears a less proportion to the whole mass of the woody matter, so must the proportion of caustic alkali be increased; and that the temperature may be raised to 350° or 370° Ft. with good effect for the rapid disintegration of dry-heart wood, or even to 400° Ft., without injury to the fibre, provided that no very great excess of alkali be present.

(For approximate amounts of pulp obtainable from several varieties of wood, see table T. C.—2, and sample pulps Nos. 50–72, corresponding to the same table.)

I find that a reduction in the percentage of caustic alkali greatly below a certain point causes the process to fail, as also does the diminution of temperature much below 320° Ft., although
284 the time of subjection to the process and proportion of alkali be increased many fold. See sample pulps, Nos. 4, 10 and Nos. 11, 22, 23, corresponding to table T. C.—1, and also plates C—7 and C—8.

A consideration of all the facts above-stated, and an examination of the products obtained from many varieties of wood, treated upon the same general principles, make it safe to conclude that the Watt and Burgess process, by chemical means under specific limitations described in its claim, certainly and efficiently removes the intercellular substance from heart wood, and yields a pure, clean, and flexible fibre, in every way superior to all other products from wood for paper-making that I have had presented to me for examination.

Q. 4. Have you made experiments upon the relative values of pressure and temperature in dissolving the intercellular matter in woody structures?

A. I have made experiments with reference to the relative values of pressure and temperature in the process of dissolving the intercellular

substance of wood by means of alkali. The result, as obtained under temperature and pressure combined, I have already related. For the purpose of ascertaining the effect of pressure without the application of heat, I have subjected poplar wood, previously soaked for seventeen hours at about 80° ft. in three times the normal amount of alkali, to an air pressure of over fifty pounds per square inch for the space of two hours, and about the same temperature, and have then compared the wood with a portion from the same block that had been placed in an open vessel in a corresponding alkaline solution for the same time, and have found no appreciable difference between them. The alkaline solutions at the conclusion of the experiments being of a similar specific gravity, indicated that pressure alone had not added to the solvent power of the alkaline bath, but that the successful solution of the intercellulose was mainly dependent upon the temperature.

Q. 5. Have you experimented with other modes of producing an oxidizing action for the solution of intercellulose? and if so, please state the result obtained.

A. I have experimented with other oxidizing agents such
285 as the permanganate of potash, chromic acid, chlorine and its compounds with oxygen.

Permanganate of potash acts with great energy upon oxidizable matters; it attacks the whole surface presented to it and destroys indiscriminately both fibre and intercellular matter.

Chromic acid is less violent, and decidedly prefers the intercellulose, but when that is nearly removed, it then begins to attack the fibres. (See sample pulps.)

Chlorine acts with much energy upon portions of the intercellular matter, especially that adhering to the surface of the fibre, but I have failed to produce a satisfactory pulp by its use alone. Its use as a bleaching agent upon pure cellulose obtained by the full action of an alkaline bath under proper pressure I suppose to be purely molecular.

From an impure pulp it would undoubtedly remove the incrust adhering to the fibre and dotted vessels, but this is done more cheaply and effectually by the proper alkaline treatment. The process of bleaching does not seem to indicate the removal of any such matters. I have carefully weighed samples of pure pulp before and after bleaching by chlorine and can find no appreciable loss. Again, the effect of the action of chlorine is not always to produce a white color; in most cases the color produced is white, but in others it has a greyish, and again a yellowish cast.

Q. 6. Are you familiar with the modes that have been adopted by microscopists to obtain wood fibre by the destruction of the intercellular tissue? and if yea, state what chemical agencies and temperatures were employed.

A. I am familiar with many modes employed for the purpose of preparing specimens of wood fibre for microscopic examination and have made use of chemical manipulations requiring the prolonged action of hot and cold water, alcohol, acetic acid, chromic acid, solu-

tions of caustic potash and soda, hydrochloric acid, and many others of like solvent power, and do not recollect to have ever seen the recommendation for the use of a temperature exceeding the boiling point in an open vessel.

286 *Cross-examined.*

By George Harding, esq., for respondents:

X-q. 1. Please point out which of the microscopic exhibits annexed to your deposition are specimens in your judgment of the action of Watt & Burgess' process, and the result accomplished by it.

A. All plate C 1, except fibre i, all C 3, (a,) C 3, (b,) C 4, (a,) C 4, (b,) C 4, (c,) C 4, (d,) C 4, (e.) I believe these are all.

X-q. 2. Have you ever obtained fibre or pulp by treating wood by boiling it in caustic alkali, then treating it with chlorine, and then with caustic alkali again, and examined it under the microscope? and if so, state how it compares with pulp obtained by boiling in alkali under pressure direct.

A. I may have assisted at making such experiment but cannot recollect. I have no memoranda upon the subject, or of the examination of such result under the microscope.

X-q. 3. What is the lowest temperature at which you have boiled wood or other vegetable matter in caustic alkali for a continuous period, for the purpose of ascertaining the minimum temperature at which the process of dissolving the intercellulose begins?

A. 300° F., as nearly as could be maintained.

X-q. 4. What is the operation or action which you think takes place above 320 F., and how much above 320° F. does it take place?

A. At 320° F., the solution of the intercellulose, in heart wood, begins, in my opinion; the temperature requiring to be varied somewhat in proportion to the dryness of the wood to be operated upon to secure perfect solution.

X-q. 5. What proportion does the heart wood bear to the whole or marketable wood?

A. To ascertain as nearly as possible the proportionate amounts of heart and sap in the woods most commonly used for paper-making, I examined several hundred cords of wood at the pulp works at Manayunk. The white poplar I found in logs varying from three inches to twenty-four inches in diameter. From measurement of many samples of various diameters, I conclude that in logs of from four to seven inches in diameter, there are eleven parts of sap wood
287 to one of heart. In the larger logs, say those which are from eighteen to twenty-four inches in diameter, and which are chiefly from the butt of the tree, there are from three to five parts of sap wood, one of heart. In many of the very small logs there was no appreciable amount of hard heart wood. An average of from twelve to fourteen inches in diameter will fairly represent the average size of the whole of the wood on hand, and will give very nearly the proportions of six or seven parts of sap to one part of heart wood. Of the resinous woods I found only white pine, and this in

logs of from seven to nine inches average diameter, and composed of nearly equal parts of sap and heart wood.

X-q. 6. Please quote from the claim of the patent of Watt & Burgess the specific limitations described therein by which the intercellulose is certainly and efficiently removed from heart wood?

(Objected to by Mr. Wallace.)

A. The treatment of wood by boiling in an alkali under pressure, "substantially as described," at, near, or above 300° F., the solution to be of a strength of about 17° Eng: Hyd.

X-q. 7. Do you think the quotation you have made conveys the idea that a temperature of 320° F., or higher, must be employed in order to remove the intercellular substances from heart wood, and give your reason therefor.

A. I do; because the expression above indicates that the 300° F. specified is the lowest limit at which practical results can be expected; and the expression that a heat and corresponding pressure of from 300° to 500° F. may be used according to the nature of the vegetable substance to be treated, indicates the necessity of the use of a much higher temperature for action upon some kinds of vegetable matter.

X-q. 8. What is the pressure that corresponds to 320° F.?

A. About sixty-four pounds to the square inch with solution 12° B., and with 2° B. seventy pounds.

C. M. CRESSON.

Sworn and subscribed before me this twenty-fifth day of October, A. D. 1867.

CHARLES SERGEANT,
U. S. Commissioner.

288 *T. C.* 1.—*Table of Experi-*

No. of experiment.	Weight of wood.	ALKALI.								HEAT.			PROD'T.	
		Caustic alkali.	Water for dilution.	Grains caustic soda.	Specific grav. Beaume.	Per ct. caustic alkali to wood.	Per ct. caustic alkali to pulp.	Per cent. of caustic alkali to proper per cent. of pulp.	Sp. gr. resultant liquid.	Temp. in boil'r Fahrenheit.	Correspond'g pres're in lbs.	Hrs. und'r boil.	Weight of pulp.	Per cent. of pulp to wood.
	Grs.								°	°			*Grs.*	
1	5250	36 f℥	.....	945	11¾	18	60	60	21	384	165	1	1577	30
3	5250	36 f℥	36 f℥	945	5½	18	47.9	51.1	...	380	165	1	1971	37.5
4	5250	f℥ f℥ *m* 27 6 24	32 f℥	756	5	14.4	35.2	41	8	376	160	1	2145	40.8
5	5250	18 f℥	54 f℥	472	2.8	9	17.5	25.5	...	378	165	1	2695	51.3
6	5250	36 f℥	36 f	945	5½	18	29.7	51.1	7	313	60	1	3181	60.6
7	5250	36 f℥	36 f℥	945	5½	18	33.2	51.1	8	313	60	2	2840	54
10	5250	f℥ f℥ *m* f℥ f℥ *m* 25 1 26 46 6 24		662	3½	12.6	28.2	35.82	6	379	165	2	2345	44.6
11	5250	72 f℥	.....	1890	11¾	36	72.2	102.2	12	316	60	1	2617	49.8
12	5250	36 f℥	.....	945	11¾	18	51.3	51.1	24	384	165	1	1840	35
13	5250	36 f℥	36 f℥	945	5½	18	49	51.1	8	384	165	2	1930	36.7
22	1312	36 f℥	.....	945	11¾	72	192.4	204.4	...	311	55	7	491	37.4
23	1312	9 f℥	9 f℥	236	5½	18	36.9	51.1	...	303	50	16	640	48.7

ments upon Pulping Wood.

Experiments, where made and when. 1866.	GENERAL REMARKS AND RESULTS OF MICROSCOPIC OBSERVATIONS.	
June 14, '66, at Am. Wood Paper Co's Works, Manay'nk.	Normal.	Green wood fresh from chipping engine. Fibres perfectly separated; is entirely and immediately soluble in sulphuric acid. Colorless solution. Pure cellulose. Bleached.
June 20, '66, at No. 417 Walnut street; wood dry; chipped for boiler June 13, 1866.	Alkali diluted with equal bulk of water.	Fibres seperated; soluble in sulphuric acid. Trace of color. Solution colorless. Bleached.
June 21, at No. 417 Walnut street.	Twenty per cent. of alkali off.	Fibres separated, but not entirely clear of incrusting matter. In sulphuric acid, light-brown solution. Bleached.
June 21st, at No. 417 Walnut street.	Fifty per cent. of alkali off.	Chippy; fibres adherent; soluble in sulphuric acid; almost black. Would not bleach.
June 21st, at No. 417 Walnut street.	Normal amount of alkali, but with reduced temperature.	Chippy; fibres not separated; apparently unaffacted, except removal of dried sap. Solution of sulphuric acid black. Would not bleach.
June 22d, at No. 417 Walnut street.	Normal amount of alkali, with temperature reduced. Double time.	Chippy; similiar in appearance to Nos. 6 and 11. Sulphuric acid blackens. Would not bleach.
June 25th, at No. 417 Walnut street.	Thirty per cent. of alkali off. Double time.	Partially pulped, but chippy; resists sulphuric acid strongly; dark-brown solution. Bleached.
June 25th, at No. 417 Walnut street.	Temperature off. Double alkali.	Similar in appearance to No. 6; sulphuric acid blackens. Would not bleach.
June 27th, at No. 417 Walnut street.	Normal solution and temperature, but with dry wood.	Fibres perfectly separated; is entirely and immediately soluble in sulphuric acid. Colorless solution. Pure cellulose. Bleached.
June 28th, at No. 417 Walnut street.	Alkali diluted, but with dry wood.	Fibres separated; soluble in sulphuric acid. Colorless solution. Pure cellulose. Bleached.
Sept. 4, '66, at No. 417 Walnut street.	Four times normal alkali. Temperature off. Soaked in alk. 35 hours. Boiled 7 times as long as Nos. 1, 3, 12.	Structures broken up, but fibres coated with incrust and adhering in bundles; not very flexible; dissolves in sulphuric acid, but makes a very brown solution. Very much resembles No. 4.
Sept. 5, at No. 417 Walnut street.	Normal alkali; temperature off; soaked in alkali 98 hours; boiled 16 times as long as Nos. 1, 3, 12.	Structures broken up, but fibres coated with incrust; dissolves in sulphuric acid, but makes a brown solution.

289 *TABLE T. C. 2.*

No. of Sample.	Name of Wood.		Percentage of Pulp.	Length of Fibre.
50	Maple	Wet	21.2	0.0300
51	Cherry	Dry	32.	0.1000
52	Yellow Pine	"	36.5	0.3750
53	White Pine	"	33.25	
54	Spruce Pine	"	32.	
55	Hemlock	"	45.	0.2675
56	Dogwood	"	35.7	
57	Ebony	"	14.5	0.0500
58	Ash	Wet	20.6	0.0625
59	Boxwood	Dry	33.64	
60	Walnut	Very dry	42.	
61	Hickory	Dry	22.6	
62	Oak	Wet	20.6	
63	Chestnut	"	27.17	
64	Birch	Dry	40.	
65	Poplar	Green	30.	.01062
66	Poplar	Dry	37.	
67	Lignumvitæ	"	15.8	
68	Mahogany	"	29.	
69	Rosewood	"	30.25	
	STRAW.			
70	Rye			0.0875
71	Wheat			
72	Oat			

The bottles containing the samples are labelled to correspond to this table.

The pulps have been treated with as nearly as possible a minimum of alkali, in order to preserve all the vessels for microscopic examination, and in some cases still contain a small amount of intercellulose, but will give with tolerable accuracy the amount of pulp obtainable.

290 In the Circuit Court of the United States for the eastern district of New York.

Examination before Kenneth G. White, esq., March 2, 1867.

THE AMERICAN WOOD PAPER COMPANY
vs.
THE FIBRE DISINTEGRATING COMPANY.

Present: Counsel for respective parties.

Hugh Burgess, produced and sworn on the part of the complainants, deposes and says as follows, viz:

and tion?

forty years old; I live at Royer's Ford, Penna.; chemist by profession.

Q. 2. Are you the person named in letters patent of the United States, issued on the 18th day of July, 1854, for a new and useful improvement in the manufacture of paper from wood, as inventor of said improvement, in connection with Charles Watt, of London, England?

A. I am.

291 Q. 3. Do you know the said Charles Watt? have you ever seen him write, and are you acquainted with his handwriting?

A. I know Charles Watt; I have seen him write, and know his handwriting of that date, 1854.

Q. 4. Have you ever seen a paper-writing executed by the said Charles Watt purporting to make John Watt his attorney? If yea, describe the general character of the same, and state what was its date, whether it was sealed, and whether the same was the genuine instrument of the said Charles Watt.

(Objection by the defendants.)

A. I have seen such paper. The purport of this paper was to enable John Watt to act as the attorney of Charles Watt, and it contained a power of substitution to a third party to act for John Watt. I do not remember the exact date of the paper; I believe it was the spring of 1854; I cannot remember the date. The paper was the genuine instrument of the said Charles Watt.

Q. 5. Was the paper you have described the genuine power-of-attorney of the said Charles Watt?

(Objection by the defendants.)

A. It was.

Q. 6. Have you made any efforts to procure the instrument you have described? if yea, with what success? Who last had possession of said instrument, and is the same now in existence?

(Objection by the defendants.)

A. I have. I have made search among all my papers, but, as I anticipated, without success, as I believe that Mr. John Watt took the paper back with him to England in May, 1854. I believe Mr. John Watt had last possession of the instrument; but as he is now dead I cannot speak confidently as to the matter. I cannot say whether the paper is still in existence.

Q. 7. Do you remember the contents or the substance of the contents of the instrument you have described? If yea, state the same fully and particularly.

(Objection by the defendants.)

A. The general purport of the papers was to constitute Mr.

292 John Watt the attorney of Mr. Charles Watt? It also contained the power to Mr. John Watt to substitute a third party in his place. I cannot give a fuller account of the contents of the paper than I have done.

Q. 8. Have you stated the contents in answer to the last interrogatory from your own recollection of said instrument?

A. I have.

Q. 9. Was the instrument that you have described executed, to

your knowledge, by the said Charles Watt, and was his signature to the same genuine?

(Objection by defendants.)

A. It was executed by Charles Watt, and the signature was genuine.

Q. 10. Were you acquainted with the John Watt you have mentioned? Have you ever seen him write, and do you know his handwriting?

A. I knew John Watt; I have seen him write, and know his handwriting, being in correspondence with him at the time of his death.

Q. 11. Look at the instrument now shown to you, and marked "Exhibit O, K. G. W., examiner, &c.," and state whether you know the A. P. Harrison whose name is subscribed as a witness to said instrument?

(Objection by defendants.)

A. I know Mr. A. P. Harrison whose name is attached as a witness to said instrument.

Q. 12. Where is the said A. P. Harrison now?

A. I believe he is in New Orleans. He told me he was living there the last time I saw him, in 1865.

Q. 13. Have you ever seen the said A. P. Harrison write, and are you acquainted with his handwriting?

(Objection by defendants.)

A. I have frequently seen Mr. Harrison write. I know his handwriting.

A. Is the signature of the said John Watt to said instrument genuine?

(Objection by defendants.)

A. It is.

Q. 15. Do you know whether the said John Watt did anything? and, if so, what, under the instrument you have described
293 as executed by the said Charles Watt, as the attorney of the said Charles Watt after the execution of said instrument, and before substituting anybody in his place?

(Objection by defendants.)

A. He attended to such matters as at that time related to the probable future sale of the patent, which was then being applied for. I remember his meeting some gentlemen who were introduced to him by Mr. F. B. Houghton, as likely to purchase the patent when granted. This was previous to my being substituted as attorney.

Q. 16. What patent do you refer to in answer to the last interrogatory?

A. I refer to the Watt and Burgess patent for the manufacture of paper from wood and other similar vegetable substances.

Q. 17. Was there ever in existence to your knowledge a paper-writing purporting to be an assignment of the American Watt and Burgess patent to Frederick B. Hougton? If yea, describe the general character of the same, state what patent was assigned, whether the instrument was sealed, and by whom it was executed.

(Objection by defendants.)

A. There was. The general character of this instrument was to transfer all the right and title of the American Watt and Burgess patent for the manufacture of paper from wood and other similar vegetable substances. The instrument was sealed. It was executed by me, individually, and also as attorney for Charless Watt.

Q. 18. Was the instrument you have described in answer to the last interrogatory the genuine instrument of the assignors therein mentioned?

(Objection by defendants.)

A. It was.

Q. 19. Have you made any efforts to procure the instrument you have described in answer to the last interrogatory but one? If yea, state of whom you have inquired touching the same, and what you have learned, who last had possession of said instrument, and is the same still in existence.

(Objection by defendants.)

294 A. I have. I have searched among my own papers and I have inquired of Mr. William F. Ladd and Mr. George Nelson and Mr. F. B. Houghton, who, in reply to my inquiry, states in a letter I now hold in my hand, "that nothing would give me greater pleasure than to send you the assignment or any other paper that might be of benefit to you, but I really have not the slightest idea of the whereabouts of any of our papers connected with the business; they may possibly be in the hands of Pattison & Wigg." He says further, "I will, with pleasure, write to Pattison & Wigg by to-day's post; if I am successful you will hear from me again shortly." This letter is dated Reading, in England, 8th December, 1866. I then received a letter from him dated Reading, England, 14th December, 1866, in which he encloses me a letter from his solicitor, Mr. Pattison, of the firm of Pattison & Wigg, in which he states, "I have had the papers searched, and also our documents, and can find no trace of any assignment from Watt & Burgess, nor do I recollect it." I believe Mr. F. B. Houghton last had the assignment in his possession. I cannot say whether it is still in existence or not.

(Answer objected to by the defendants.)

Q. 20. Do you know the F. B. Houghton you have mentioned? have you ever seen him write, and are you acquainted with his handwriting?

(Objection by defendants.)

A. I know Mr. Houghton; I know his handwriting; have seen him write.

Q. 21. Is each of the letters to which you have referred in your answer to the last interrogatory but one, under date of 8th December, 1866, and 14th December, 1866, respectively, in the handwriting of the said F. B. Houghton, and is his signature to each of the same genuine?

(Objection by defendants.)

A. It is, and the signature to each of them is genuine.

Q. 22. Was each of said letters received by you in due course of mail?

(Objection by defendants.)

A. The first letter, bearing date the 8th of December, was handed to me by his brother, Vas Houghton, it being enclosed to him by F. B. Houghton in a letter from England. The second letter I received, I believe, in due course of mail.

295 Q. 23. Do you remember the contents or the substance of the contents of the assignment you have described in answer to preceding seventeenth interrogatory? If yea, state the same fully and particularly.

(Objection by defendants.)

A. I remember the substance of the contents of the assignment. It was to convey all the right, title and interest in the Watt & Burgess American Patent for the manufacture of paper from wood and other similar vegetable substances to F. B. Houghton for the sum of £5,000; one thousand pounds of which was to be paid in cash, and the remainder in notes at nine and eighteen months.

Q. 24. Was said assignment of the American Watt & Burgess Patent to F. B. Houghton executed by you? If yea, in what capacities? and was your handwriting thereto as attorney for Charles Watt genuine? and was your signature thereto genuine?

(Objection by defendants.)

A. It was executed by me individually and as attorney for Charles Watt, and my signature in both cases was genuine.

Q. 25. Was there any agreement to sell the American Watt & Burgess Patent to Frederick B. Houghton after you were substituted for John Watt as the attorney for the said Charles Watt to sell said patent, and before you disposed of any interest individually or otherwise in said patent? If yea, in what capacity did you make said agreement? what were the terms of the same, and what was done in performance thereof?

(Objection by defendants.)

A. There was such an agreement made between myself and Mr. F. B. Houghton after my substitution as attorney for John Watt and previous to the assignment being made. I made the agreement individually, and as attorney for Charles Watt; the terms were the same as those stated in the assignment. The assignment was drawn and executed in accordance with the agreement. I handed the assignment to Mr. Houghton and he paid me £675, and gave me the notes at nine and eighteen months for four thousand pounds, according to the terms stated in the agreement.

296 Q. 26. Was any portion of the consideration you received for said assignment from F. B. Houghton received by the said Charles Watt? If yea, what portion, and how was the same remitted?

(Objection by defendants.)

A. Of the cash received I remitted Mr. Charles Watt a bill of exchange for £625. I also sent Mr. Houghton's note at eighteen months for £1,562 10*s*., and also Mr. Houghton's note at nine months for £937 10*s*. The other notes I retained.

Q. 27. Was anything done, to your knowledge, and if so what, by the said F. B. Houghton, as the owner of the American Watt & Bur-

gess Patent, under said assignment to him, in reference to said patent and the business of manufacturing under it, after the execution of said assignment, and before the said F. B. Houghton disposed of his interest in said patent?

A. As owner of the said patent he made arrangements, the nature of which I do not exactly know, with Mr. M. L. Keen to commence manufacturing paper pulp from wood. Such arrangements were carried into effect. This was previous to said F. B. Houghton's disposal of his entire interest in said patent.

Cross-examined.

By Mr. Gifford, for defendants:

Q. 28. What connection, if any, have you with the American Wood Paper Company, the complainants in this suit?

A. I am chemist to the company.

Q. 29. Have you any interest in that company? If yea, specify what it is.

A. I have an interest in the company, holding nearly nine hundred shares of the stock of the company.

Q. 30. How much is the stock per shares at par value?

A. The par value of the stock is $100 a share.

Q. 31. Are you an officer of that company, or have you at any time been so? If yea, when?

A. I am chemist to the company, but not an officer of the company.

Q. 32. How long have you been interested in that company as a stockholder?

A. Since the formation of the company, in 1863.

Q. 33. Where are the works of the company?

297 A. One mill is situated at Manayunk, near Philadelphia; the other at Royer's Ford, Pennsylvania.

Q. 34. Have you been before examined in this case? If yea, where and when?

A. I have been examined in this case previously, in Philadelphia.

Q. 35. Did you, on that examination, produce any samples of the material which could be used in the manufacture of paper pulp, or of paper?

(Objection by complainants, as not proper matter for cross-examination.)

A. I did:

Q. 36. By whom, where, and when were those samples made?

(Objection by complainants for same reason.)

A. The samples I allude to were made by the Fibre Disintegrating Company, at Brooklyn, in September, I believe, in 1865.

Q. 37. Why do you say you believe instead of answering upon your own knowledge?

(Objection by complainants for same reason.)

A. Because, without refreshing my memory from my notes, I cannot speak positively as to the exact time.

Q. 38. What person or persons, if you know, made those samples?

(Objection by complainants for same reason.)

A. I do not know the person who made the samples; but I collected them at the works of the company, from material under process of manufacture.

Q. 39. Then you did not see those samples made, did you?

(Same objection.)

A. The samples of brown paper I saw made; but not those bleached samples made from bamboo and other materials.

Q. 40. How long were you at these works at the time you say you gathered those samples, and with whom, if any one, did you converse while there?

(Same objection.)

298 A. I was there for perhaps an hour and a half. I conversed with Mr. Townsend. I do not now remember the initials of Mr. Townsend. He was introduced to me as the superintendent.

Q. 41. If, in your examination in this case, you have stated that the samples above referred to are substantially in the same condition and of the same character as pulp produced by the reissued patent No. 1,448, and are produced substantially by the same process as that described in reissued patent number 1,449, then state what, in giving that answer, you assumed the process, described in the reissued patent number 1,449, to be?

(Same objection.)

A. I assumed that the process, described in reissued patent, No. 1,449, is the removal of the intercellular tissue by the action of caustic alkili at a certain temperature.

Q. 42. Explain, in detail, what you assumed that process to consist of?

(Same objection).

A. This process consists in the subjecting of wood and similar vegetable substances to the action of caustic alkail of a given strength, which should be about 12° Baume, to a temperature of about 370° Fahrenheit; but this temperature must vary with the character of the material under operation.

Q. 43. In comparing the above-named samples with the process contained in said patent, how much did you assume that the temperature might be varied and still be within the process contained in the patent?

(Same objection.)

A. We claimed in the patent a temperature at, near, or about 300° Fahrenheit, and I assumed that we had the right to vary the temperature according to the material under operation to about that point; that is, at, near, or about 300° Fahrenheit.

Q. 44. In giving your testimony, at how much below 300 degrees did you assume would be within the process contained with the patent?

(Same objection.)

A. Within eight or ten degrees, or at such a temperature as would effect the desired object, namely, the removal of the intercellular tissue.

Q. 45. Suppose that the temperature of two hundred de-
299 grees would effect such removal, would that, according to your understanding of it, be within the process?

(Same objection.)

A. It would not.

Q. 46. Why not?

(Same objection.)

A. Because, from the experiments made previous to the granting of the patent, I did not find that caustic alkali in solution, at such temperature, would remove sufficient of the intercellular tissue to make a good pulp, and therefore I did not consider such a low temperature sufficiently effective to be included in the patent.

Q. 47. Then you consider, do you, that the question as to whether the temperature would or would not be within the process of the patent, depends upon whether the boiling removes the intercellular tissue sufficiently to make a good pulp?

(Same objection.)

A. I do; as the object of the process is the production of a pulp capable of making a fair quality of paper.

Q. 48. In giving your testimony, have you assumed that boiling in a solution of caustic alkali, under a pressure of 200° Fahrenheit, would be within the process of the patent?

(Same objection.)

A. I believe it would not be within the limits of the patent.

Q. 49. Why not?

(Same objection.)

A. Because I do not believe that at that temperature a workable pulp could be produced, except with the aid of very strong solutions and great length of time, which would prevent the process from being a mercantile success.

Q. 50. If you were to find a man boiling a material that is a wood or vegetable substance in a solution of caustic alkali, under a pressure of 250°, and thereby making good pulp for paper, would he, in your judgment, be practising the process described and specified in said patent?

(Same objection.)

A. If the temperature of the solution, in which the vegetable substance was being boiled, was 250° Fahrenheit, I should not consider him as touching the patent in question.

300 Q. 51. How would it be if he used a temperature of 260° Fahrenheit?

(Same objection.)

A. If the temperature of the solution was 260°, I do not consider he would be infringing the patent.

Q. 52. How would it be if he were using a solution at a temperature of 270?

(Same objection.)

A. I do not consider that at that temperature he would be infringing the patent, provided the solution was at that temperature.

(Same objection.)

Q. 53. How would it be if he was using a solution of 280° temperature Fahrenheit?

(Same objection.)

A. I do not think he would be infringing the patent.

Q. 54. How would it be if he were using a solution at a temperature of 290° Fahrenheit?

(Same objection.)

A. I consider that would come within the meaning of the words, at, near, or about 300° Fahrenheit.

Q. 55. At what temperature of the solution between 280° and 290° do you think the process of the patent would commence?

(Same objection.)

A. It is almost impossible for me to state within a degree or two the effect of caustic alkaline solutions upon all vegetable substances, as temperature, per cent. of alkali and length of time greatly vary with the character of the vegetable substance under operation, and therefore the words, at, near or about, were purposely used in the patent.

Q. 56. You say you cannot state within a degree or two; state as nearly as you can.

(Same objection.)

A. With vegetable substances of such mature growth as would make them applicable for paper pulp purposes, to the best of my belief, I do not think a temperature under 290° could be successfully used, though young vegetable snbstances might be pulped at that temperature.

301 Q. 57. Do you think that young vegetable substances might be pulped at a temperature of the solution below 290° Fahrenheit? and, if yea, how much below?

(Same objection.)

A. I have pulped young vegetable substances at a temperature lower than that, but I cannot remember now the precise temperature employed.

Q. 58. Do you know what temperature of the caustic solution would be equivalent to sixty pounds steam pressure?

(Same objection.)

A. That will depend upon the density of the solution. At 5° Baume, the temperature would be about 310° Fahrenheit, but, as the solution became charged with vegetable matter, the temperature would rise above that amount.

Adjourned to Saturday, March 23d, at 11 o'clock.

RESUMED MARCH 23D, 1867.

Present · Counsel for respective parties.

Q. 59. In boiling water, what degree of temperature would represent or be equivalent to a steam pressure of sixty ponnds to the inch?

(Same objection.)

A. About 310°; that is, the water would be about 310°.

Q. 60. What scale do you use in making the computation?

(Same objection.)

A. Fahrenheit's scale.

Q. 61. You say that in boiling with an alkaline solution of 5° Baume, sixty pounds pressure is equivalent to 310° of temperature of the solution, Fahrenheit. Is the temperature higher in this case than it would be of the water, if the boiling was in water, instead of the alkaline solution?

(Same objection).

A. If, in answer to interrogatory No. 58, I stated that the temperature of an alkaline solution of 5° Baume, was 319° Fahrenheit, at sixty pounds pressure, I made an error, as it should be 313°; consequently the temperature of a solution of 5° Baume is about three degrees hotter than water, both being at a pressure of sixty pounds.

302 Q. 62. What do you understand that difference to be attributed to?

(Same objection.)

A. From the known law that temperatures of solutions increases with their densities.

Q. 63. At what steam pressure do the complainants, in practical operation, boil vegetable substances in alkaline solutions?

(Same objection.)

A. We practically use, with non-resinous woods, a pressure of about 140 pounds, with resinous woods a pressure of about 105 pounds.

Q. 64. How many degrees of temperature would that pressure represent of the alkaline solution in which you boil, and what is the strength of that solution?

(Same objection.)

A. I have not all my tables of pressures and corresponding temperatures with me, but I believe that in a caustic alkaline solution of 12° Baumé, which is the strength we ordinarily use, a pressure of 140 pounds is about equivalent to a temperature of 366°, and that a pressure of about 150 pounds with the same strength of solution is about equivalent to a temperature of 372°.

Q. 65. Do you consider boiling in a temperature of 366° to be boiling at a temperature of "at, near, or about" 300°?

(Same objection.)

A. No, I do not.

Q. 66. Why not?

(Same objection.)

A. Because a temperature of 366° is not at, near, or about 300°.

Q. 67. Do you consider rags, linen and cotton ropes, to be vegetable substances, within the patent No. 1,449?

(Same objection.)

A. No, I do not.

Q. 68. Why not?

(Same objection.)

A. Because in linen and in cotton there is no intercellular
303 matter; whereas in the vegetable substances referred to in the patent there is a very large amount of intercellular matter.

Q. 69. What vegetable substances are referred to in the patent, as you understand it?

(Same objection.)

A. Wood and vegetable substances possessing ligneous tissues.

Q. 70. As you understand it, what vegetable substances, as such, are not, or should not, be included in the patent?

(Same objection.)

In taking out the patent, I intended that it should apply to all vegetable substances containing ligneous matter, and I know of no vegetable production that does not contain ligneous matter, when it has arrived at its maturity.

Q. 71. Do you consider cotton-waste to be a vegetable substance within the meaning of said patent?

(Same objection.)

A. No, I do not.

Q. 72. Why not?

(Same objection.)

A. Because clean cotton is pure cellulose or fibre, and contains no ligneous matter, as usually understood by that term.

Q. 73. Then you would not consider boiling cotton waste in a solution of alkali under a pressure equivalent to three hundred degrees temperature within that patent, would you?

(Same objection.)

A. I should not.

Q. 74. At the time you state you visited the defendant's works at Brooklyn, did you see there in use what is known as the Spofford boiler?

(Same objection.)

A. Mr. Townsend did not show me such a boiler.

Q. 75. Did he show you any boiler? if yea, how many?

(Same objection.)

A. He showed me, I think, two upright boilers, and also the boilers used for generating steam.

Q. 76. Were the two upright boilers alike?

(Same objection.)

A. To appearances, of what I saw, I should think they were.
304 Q. 77. To what extent did you examine them?

(Same objection.)

A. Both boilers were closed with their man-heads at the time of my visit. I therefore could only see the outside of the boiler, that is the top where they were charged, and the lower portion, where the contents of the boiler were discharged.

Q. 78. If you have testified in this case that you have examined the letters patent issued to Morris L. Keen, bearing date September 13th, 1859, and June 16th, 1863, and that you fully understand the invention therein described and claimed, then state what you understand

to be the invention described and claimed in the one of those patents dated September 13, 1859.

(Same objection.)

A. I understand it to be a boiler placed vertically, and provided with a proper mode of keeping the contents of the boiler submerged beneath the solution; also provided with a suitable valve or gate for the discharge of the contents of the boiler from the lower end. It is also provided with stirrers and necessary steam-gauge.

Q. 79. Can you swear that either of the two upright boilers which you say Mr. Townsend showed you at the defendant's works had stirrers? If you can, then please describe such stirrers.

(Same objection.)

A. As both the boilers were closed, I could not see into their interior; but I saw on the outside of one, if not both, a geared arrangement, which Mr. Townsend told me was for the purpose of driving the stirrers. I think I understood him that the stirrers were not successful, and they thought of removing them, or perhaps had removed them at the time of my visit. My impression is, that certainly one of the boilers was provided with stirrers at that time. I cannot describe these stirrers.

Q. 80. In giving your testimony in this case, have you assumed that such a boiler as you saw at the defendant's works would be within said patent, even if it did not contain a stirrer.

(Same objection.)

305 A. I assumed that if the boilers that I saw at the defendant's works did not contain a stirrer, they would not come within the limit of the Keen patent of the date of September 13th, 1859.

Q. 81. What have you assumed with reference to a necessity of a stirrer being of any particular kind to bring it within that patent?

(Same objection.)

A. I have assumed that in Keen's patent of September 13, 1859, he claims an arrangement of stirrer in connection with a boiler of that peculiar form and position.

Q. 82. Do you mean that it comprehends stirrers of all forms and all modes of operation?

(Same objection.)

A. No, I do not; I consider that the stirrers should be substantially of the same character and for the same purpose as those described in said Keen's patent.

Q. 83. What form of stirrers have you assumed are included in that patent and what excluded therefrom?

(Same objection.)

A. I assumed that the stirrers should be of the same character as described in Keen's patent; I do not think that stirrers widely differing from the arrangement therein described would fall within the limits of that patent, so far only as relates to the stirrers.

Q. 84. Explain what you mean in your last answer by the words "same character?"

(Same objection.)

A. By the same character I mean upright shafts, provided with arms, the whole forming a stirrer, revolving parallel to the long axis of the boiler.

Q. 85. In the boilers employed by the complainants in their works at Royer's Ford, are stirrers used?

(Same objection.)

A. They are not.

Q. 86. Have they ever been there?

(Same objection.)

A. They were used in a small boiler I believe.

Q. 87. How many boilers for boiling material under pressure in alkaline solution are in use at that establishment?

306 (Same objection.)

A. Four.

Q. 88. How long have they been in use there?

(Same objection.)

A. Since, I believe, July, 1860.

Q. 89. Is the small one you have above mentioned one of those four?

(Same objection.)

A. It is not.

Q. 90. Have the complainants any other works than those at Royer's Ford?

(Same objection.)

A. They have.

Q. 91. Where? and state if you know whether stirrers are used in their boilers there?

(Same objection.)

A. The works are at Manayunk, near Philadelphia; stirrers are not used in the boilers at those works.

Q. 92. How do you get along without stirrers?

(Same objection.)

A. There is no necessity for using stirrers in boiling wood, as the wood retains the form in which it is placed in the boiler, thus allowing the convective currents of the alkaline solution to travel freely through the mass and thus keeping up the necessary circulation.

Q. 93. Are you acquainted with the ordinary Spofford boiler?

(Same objection.)

A. I am.

Q. 94. What do you understand to be the difference between that boiler and the one described in the patent to Keen, dated 13th September, 1859?

(Same objection.)

A. The differences are these: From the vertical portion of Keen's boiler, and from the position of the gate or valve at its lower extremity, and from the man-head or charging hole being placed at the top, it presents great facilities for the charging and discharging of the boiler; and from the heat being applied at its lower end and sides, the heating of the boiler by the natural ascending power

307 of the convective currents is much greater than in a boiler of

a horizontal position. In the Spofford boiler it is usually heated by steam introduced through one of the trunnions, and consequently the absorption of heat by the contents of the boiler takes place from the heating of the upper skin of the boiler which is exposed to the steam, as this heated portion of the boiler in its revolution dips below the liquid contents of the boiler. The passage of the steam through the liquid contents of the boiler near the trunnions of the boiler, if the liquid contents of the boiler are above the trunnion, gives rise to very partial heating of the contents of the boiler, unless long time is employed in boiling. From its rotary motion it is apt to tangle and roll the solid contents of the boiler, if they are long in their character.

Cross-examination continued.

By Mr. Law, counsel for defendants:

Q. 95. In your answer to the 59th interrogatory you state that in boiling water, under a steam pressure of sixty pounds to the inch, the the water would be about 310° Fahrenheit; does not 300° Fahrenheit represent, according to the scale of the French academy, a pressure of between sixty-six and sixty-seven pounds to the inch?

(Same objection.)

A. In the experiments of the French academy, I believe that they take the total internal pressure of the vessel in which the experiment was made; that is to say, they do not calculate the fifteen pounds atmospheric pressure, but consider that a vacuum in the vessel represents what in the English mode of computation would be taken as the starting point from which to reckon steam pressures, and consequently that in all French industrial publications about fifteen pounds should be deducted from their stated pressures. This, with the thermometric errors usually made in calculations of steam pressures and internal temperatures, accounts for the variation alluded to in this interrogatory. Therefore, 300° Fahrenheit represents, according to the scale of the French academy, a pressure of somewhere about sixty-six pounds.

Q. 96. What is the difference, if any, between Lardner's scale and that of the French academy?

(Same objection.)

A. I cannot answer the question off-hand without notes or
308 books, as I never trust to my memory for the endless calculations and figures in physics or chemistry.

Q. 97. Is not Lardner's scale based upon the English mode of computation, which you have referred to in your last answer but one?

(Same objection.)

A. I do not, at the present moment, remember Lardner's scale; neither do I know the date of the Lardner scale referred to, as great improvements have been lately made in the modes of taking pressures and internal temperatures; and consequently all the tables, to a certain extent, vary.

Q. 98. What scale do you use in making your computation, given in your answer to the fifty-ninth interrogatory?

Same objection.)

A. In the note-book from which I have taken temperatures of solutions corresponding to certain steam pressures, I have used a table prepared by Professors Cresson and Rand, and myself, as I am not aware that any tables exist in which the temperature of solutions of varying densities at same steam pressures exist. These tables were prepared with very great care, and every precaution was taken to prevent error.

Q. 99. The fifty-ninth interrogatory inquires as to the temperature of boiling water under certain pressure, and has no reference to solutions; can you refer to any published scale in support of your answer to the fifty-ninth interrogatory?

(Same objection.)

A. The table from which I gave my answer to interrogatory fifty-nine was also compiled by Professors Cresson, Rand, and myself; but it closely coincides with, I believe, Sewell's table, lately published.

Q. 100. Who is Sewell, and when and where was his table you refer to lately published?

(Same objection.)

A. I do not know who Sewell is. I believe the table is published in one of the hand-books on scientific subjects, published by a London firm, but I do not remember their name.

Q. 101. Before you applied for your patent of 1854, you
309 were aware, were you not, that rope and rags had been boiled in alkaline solution, under pressure, to make paper pulp?

(Same objection.)

A. I was.

Q. 102. The Spofford rotary boiler was commonly used for that purpose, was it not?

(Same objection.)

A. There was a rotary boiler in use in England, similar to the Spofford boiler, at that time and for that purpose.

Q. 103. Are you not aware that a pressure of sixty pounds was sometimes used in that kind of boiler?

(Same objection.)

A. At that time I was totally ignorant of the amount of steam pressures used in the rotary boilers referred to.

Q. 104. Have you not since learned that in such boilers a pressure of sixty pounds had been sometimes used previous to the time when you applied for your patent of '54?

(Same objection.)

A. I do not at present recollect ever hearing that, previous to 1854, a pressure of 60 pounds had been made use of in rotary boilers referred to.

Q. 105. In what respect does your reissued patent No. 1,449 differ from Mellier's patent, dated May 26, 1867, referred to in the bill of complaint in this case?

(Same objection.)

A. The reissued patent 1,449, differs from Mellier's patent above referred to, in that it includes wood and similar vegetable substances, while Mellier's patent is only confined to straw or fibrous material. I

consider that the reissued patent 1,449, embraces the Mellier patent above referred to, as I consider straw, &c., a "similar vegetable substance."

Q. 106. If you discovered any new effect produced by a boiling of vegetable substances in an alkaline solution of a specific temperature, please state what is that temperature, and what is the new effect discovered by you.

(Same objection.)

A. In 1853, the new effect I produced by boiling vegetable substances in alkaline solutions was the total removal of the intercellular tissue, leaving the cellulose pure, which, to the best of my belief, had never been previously effected. I found that a definite
310 temperature was necessary to obtain this desired end, this temperature varying with the nature of the vegetable substance being operated upon. For resinous woods, a temperature of the solution of about 372° Fahrenheit was necessary; for non-resinous woods, a temperature of the solution of about 366°; for vegetable substances of a less solid character than wood, a temperature of somewhere about 300°.

Q. 107. In answer to the 67th cross-interrogatory you state you do not consider rags, linen, and cotton ropes to be vegetable substances within the meaning of the patent No. 1,449; how would it be with hemp-rope, hemp, or flax?

(Same objection.)

A. I believe that unbleached hemp-rope and flax come within the catagory of the vegetable substances included in the patent, provided that the total removal of the intercellular matter is the object arrived at, which can only be effected at a pressure above that equivalent to the lowest limit of temperature mentioned in the patent.

Q. 108. State why you make a difference between cotton waste and dressed flax, unbleached.

(Same objection.)

A. Because cotton waste is pure cellulose contaminated with various matters, and which can be removed by boiling at a moderate temperature in alkaline solutions, while unbleached flax still contains the intercellular matter, binding the ultimate fibres together, and the removal of this intercellular matter requires the alkaline solution to be of a much higher temperature than is necessary for the simple removal of oil and dirt from cotton waste, as in the former case a decomposition has to be effected, while in the latter a simple saponification.

Q. 109. Suppose a party should take paper pulp manufactured from hemp, flax, or other vegetable fibres from which paper could be made, without any subsequent boiling in an alkaline solution at a temperature above 290°, and should put that stuff into a boiler and boil it in an alkaline solution under a pressure of seventy-five pounds, would that be treating a vegetable substance within the meaning of the patent No. 1,449?

(Same objection.)

311 A. It would not.

Q. 110. What is the process used by the complainants at their works to make paper pulp?

(Same objection.)

A. The removal of intercellular tissue of vegetable substances by caustic alkaline solutions of certain strengths and temperatures, thereby producing a pure, or nearly pure, fibre, which constitutes paper pulp.

Q. 111. Did you, in the year 1854, assist in the application to the Patent Office for the patent granted to you and Watt in that year, and did you assist in the preparation of the correspondence with the Patent Office, connected with such application?

(Same objection.)

A. I did.

Q. 112. Look at the paper now shown you, and marked "Defendants' Exhibit A, K. G. W., examiner, &c.," purporting to be a copy of a letter written by A. B. Stoughton for Watt and Burgess, dated Washington, April 7, 1854, and directed to the Hon. Charles Mason, Commissioner of Patents, and state what you know in reference to such letter, and whether the original was a part of the correspondence with the Patent Office, in connection with your application for the patent granted to you and Watt in 1854?

(Same objection.)

A. I know nothing relating to such letter, and I cannot say whether the original was a part of the correspondence with the Patent Office; but I have no doubt it was.

Q. 113. Do you now use, in the words of the complainants, the order and series of processes described and set forth in this letter, marked "defendants' Exhibit A," and therein stated to constitute the invention?

(Same objection.)

A. Yes; with certain highly resinous woods we do, with this exception, that we first boil in caustic alkali, under pressure, as mentioned in the patent, and use chloride of lime in solution instead of chlorine, on account of economy; that is to say, highly resinous wood is first boiled, under pressure, in caustic alkali, then subjected to the action of bleaching powder in solution; again treated with alkali, and
312 subsequently bleached. In old resinous woods we have great difficulty in obtaining a good color, except by this means. We do not use this process in the order in the letter referred to in non-resinous woods.

Examination resumed.

MONDAY, *March 25th*, 1867.

Present: Counsel for respective parties.

Q. 114. Have not the complainants made some paper pulp for packing paper, at their works at Manayunk and Royer's Ford, by boiling chips of wood in an alkaline solution, and then made such pulp into packing paper, without subjecting the material, after such boiling, to the subsequent action of chlorine or its compounds with oxy-

gen, and without again subjecting the material to the action of a weak solution of caustic alkali?

(Same objection.)

A. They have, at Royer's Ford; but, to the best of my belief, they have not done so at Manayunk.

Q. 115. In making pulp from non-resinous wood for white paper, do you first boil the wood in alkaline solution, then wash, and then subject the stuff to the action of chlorine or its compounds with oxygen; then wash, then subject the material to the action of a weak solution of caustic alkali, and then wash and bleach the material?

(Same objection.)

A. If the non-resinous wood is old and difficult to bleach, we follow the above order; and, in connection with this, I wish to state, that in my answer to cross-interrogatory 113 I ought to have added, that in old non-resinous woods we use the materials in the order as set forth in that interrogatory.

Q. 116. How is it with respect to non-resinous woods not old?

(Same objection.)

A. We only follow that order to a certain extent; that is to say, we do not use the subsequent treatment with weak caustic alkali, and the final treatment with the hypochlorides.

313 Q. 117. Do you commonly use non-resinous woods that are not old?

(Same objection.)

A. We endeavor to get young wood, and usually use young wood.

Q. 118. When did you last use old non-resinous wood, and what proportion of the whole quantity used of such wood has been old?

(Same objection.)

A. To the best of my belief, the last time that the above mode of using caustic alkali, hypochloride, again alkali and bleach, or hypochloride, was about two or three months ago, but as I am little at the mill I cannot be exact as to the time. I don't think we used more than five per cent., or perhaps not as much, of old non-resinous wood at this time. To the best of my belief, I do not think that the whole proportion of old wood has been greater.

Q. 119. Cannot useful merchantable paper pulp be profitably made from straw by boiling it in a solution of caustic alkali at a temperature less than 290° Fahrenheit?

(Same objection.)

A. To the best of my belief, a fair quality of pulp might be produced at this temperature if a considerable quantity of alkali and lime was employed, but the quality of the pulp would not be of a first-class character.

Q. 120. Cannot the pulp made, as stated in the last question, be advantageously mixed with manilla to make packing paper?

(Same objection.)

A. I should think it could.

Q. 121. Please refer to your answer to the 49th cross-interrogatory, and state whether a workable pulp cannot be produced from straw by boiling the same in an alkaline solution below the temperature there

referred to, and without the aid of very strong solution, and without boiling the same for a great length of time, and so as to be a mercantile success?

(Same objection.)

A. I do not think that a "workable pulp;" that is to say, a pulp that will make a fair class of merchantable paper, could be
314 produced at that pressure, except a considerable quantity of other fibrous material was mixed with it.

Q. 122. Cannot merchantable paper be made from bamboo or reeds by boiling the same at a lower temperature than 290° Fahrenheit in an alkaline solution of less than half the strength now used by you in boiling chips of wood?

(Same objection.)

A. I think that a brown paper could be made by boiling bamboo or reed in a caustic alkali below 290°, and with the strength of alkali referred to; but my experience is that the paper would not be of a very strong quality.

Q. 123. Look at the material now shown you, and marked "defendants' Exhibit B, K. G. W., examiner, &c.," and state whether, in your opinion, a workable paper pulp could be made from that material by boiling the same six hours at a lower temperature than 290° Fahrenheit in an alkaline solution, of the strength of 6° Baumé?

(Same objection.)

A. I cannot answer this question, because the words "in an alkaline solution of the strength of 6° Baumé" does not give me the absolute quantity of alkali used to the pound of dry vegetable substance.

Q. 124. Suppose the quantity of alkali used is one-half to the pound of dry vegetable substance of that used by you in treating wood-chips?

(Same objection.)

A. I think with that quantity of alkali stated in the last interrgatory that a brown paper of fair quality could be produced from the material, defendants' Exhibit B, but am under the impression that the paper would not be of a very strong quality.

Q. 125. Look at the material now shown you, marked "Defendants' Exhibit C, K. G. W., examiner, &c.," and state whether, in your opinion, the material, defendants' Exhibit B, would make this article, defendants' Exhibit C, by boiling the material, Exhibit B, in an open vessel less than twelve hours in an alkaline solution, in which twelve pounds of caustic soda of commerce is used for sixty-two pounds of the crude dry material, defendants' Exhibit B, producing
315 after washing and bleaching with chloride of lime, forty-one pounds of the bleached material, Exhibit C.

(Same objection.)

A. I think that it is probable that the material marked Exhibit C might be produced from the material marked Exhibit B, by the use of the quantity of alkali stated in the last interrogatory, provided that a considerable quantity of bleach powder was employed and considerable pains taken in the mode of bleaching; but I believe that

the greater part of the intercellular matter adhering to the fibre is removed by the oxidizing agency of the bleaching liquors.

Q. 126. Do not the complainants boil wood-chips in alkaline solution, and then, when white paper pulp is required, proceed to bleach the same by the usual process of bleaching? If not by the usual process of bleaching, then state by what process the bleaching is effected.

(Same objection.)

A. In young wood, after boiling in an alkaline solution, they bleach much in the usual manner.

Q. 127. Do the complainants, after boiling the wood-chips in an alkaline solution, follow the directions contained in the patent number 11,343, issued to Watt & Burgess on the 18th of July, 1854, and given in the following passage in said patant: "The shavings are then to be well washed and pressed, and the washing may be saved and evaporated down and burned in a suitable furnace, when they are again available for the same purpose. The damp shavings are now to be exposed to the action of chlorine, or of the compounds of chlorine with oxygen, till, on a portion being placed in a dilute solution of caustic alkali, the vegetable substance falls into a dark, pulpy mass?" (Defendants' counsel puts in evidence a certified copy of the patent referred to in last question, which is marked "Defendants' Exhibit D.")

(Same objection.)

A. They do not do so at the present moment; but, under certain circumstances, they would employ that process.

Q. 128. Under what circumstances would they employ that process?

(Same objection.)

A. If the price of salt-cake rose sufficiently as to reduce
316 the cost of chlorine, the salt-cake being a product of the elimination of hydrochloric acid, and if the price of manganese fell so that the production of chlorine from the said hydrochloric acid could be cheaply effected so that the compound process could be cheaply conducted, it would be employed.

Q. 129. Do the complainants, after the treatment mentioned or referred to in the last question but one, follow the further directions of the said patent of 1854, as contained in the following passage: "The shavings are now to be placed in a weak solution of caustic alkali, when they will into a pulpy mass of a dark-brown color?"

(Question withdrawn.)

Q. 130. Do the complainants, after the treatment mentioned or referred to in the 127th cross-interrogatory, follow the directions of the said patent of 1854, as contained in the following passage: "The pulp obtained as above described, having been freed from the alkali by washing (which may be saved as before directed) may now be bleached by the usual process, or, as we prefer, by chlorite of hypochlorite of soda or potash liberating the chlorous or hypochlorous acid by hydrochloric acid?"

(Same objection.)

A. We do, with the exception that we obtain the hypochlorous acid from the hypochlorite of lime, using sulphuric acid or hydrochloric acid, as is most convenient.

Q. 131. Do you consider that the process now used by the complainants is what you and Watts claimed as your invention, in the following passage in the said patent of 1854: "But what we do claim as our invention, and desire to secure by letters patent, is the pulping and disintegrating of shavings of wood and other similar vegetable matter for making paper by treating them with caustic alkali, chlorine, simple or its compounds with oxygen and alkali in the order substantially as described?"

A. I do.

Q. 132. Why?

(Same objection.)

A. Because, in the first treatment by caustic alkali, boiling
317 under pressure is referred to. We do not limit ourselves to the amount of pressure to be used, and the subsequent processes are now frequently carried out, though we occasionally omit some of them, when, from the character of the material under treatment, it is not necessary to use them.

Q. 133. Did you mean and intend that the claim in the said patent of 1864 for the process therein described for the pulping and disintegrating of shavings of wood and other similar vegetable matter for making paper should include straw boiled in an alkaline solution under high pressure to make white paper?

(Same objection.)

A. We intend to include vegetable substances which would include straw.

Q. 134. Did you mean to include vegetable substances not similar to shavings of wood?

(Same objection.)

A. At the time of my invention, in 1853, I believed I was the only person who had pulped or disintegrated vegetable substances; and by the words "vegetable substances" I intended to include such plants in the vegetable world whose fibres could be converted into pulp for paper making purposes, by the destruction of their true intercellular matter.

Q. 135. Did you mean and intend that the claim in said patent of 1854 should include straw boiled under a pressure of less than fifty pounds?

(Same objection.)

A. I did; but at pressure above atmospheric pressure.

Q. 136. Did you mean and intend that the claim in said patent of 1854 should include straw boiled in an alkaline solution at a temperature of 212° Fahrenheit in an open vessel?

(Same objection.)

A. Not unless the subsequent treatment described in the patent was employed, as I found that unless considerable pressure was used I could not dispense with the oxidizing agency of chlorine or its compounds with oxygen for the destruction of the intercellular matter;

but I considered that I could boil straw at a temperature of 212°, provided I employed the subsequent treatment described in the patent.

Q. 137. Did you not know when you applied for said patent
318 of 1854 that paper was then made from straw boiled in alkaline solution in an open vessel?

(Same objection.)

A. I did; but I knew of no process in which the subsequent treatment was carried out when the straw was boiled at 212°, similar to that described by us.

Q. 138. Did you intend to claim a patent for the process of boiling straw in an open vessel in an alkaline solution?

(Same objection.)

A. Not without the subsequent treatment described in the patent.

Q. 139. Does not the patent of 1854 include a boiling not under pressure in an alkaline solution?

(Same objection.)

A. It does so, provided that the subsequent treatment therein described is adopted.

Q. 140. If the subsequent treatment described in said patent is not adopted, does that patent include a boiling not under pressure in an alkaline solution.

(Same objection.)

A. It does not.

Q. 141. In the claim of your patent of 1854, you use the expression "shavings of wood and other similar vegetable matter." What vegetable matter do you consider to be similar to "shavings of wood?"

(Same objection.)

A. Substances containing ligneous intercellular matter binding the true fibre together.

Q. 142. Do you consider flax and hemp to be vegetable matter similar to shavings of wood, within the meaning of the language quoted in the last question from your patent of 1854?

(Same objection.)

A. I consider raw flax and hemp similar to shavings of wood within the meaning of the language quoted, because the ultimate fibres themselves are connected together by true intercellular matter, which by oxidation is converted into humic and ulmic acids, precisely similar to the intercellular matter from wood.

319 Q. 143. Do you consider that no one in the United States after the granting of your patent in 1854 could make paper pulp or material for paper from straw, flax, or hemp by boiling the same in an alkaline solution, either in an open vessel or under pressure, without first obtaining an authority so to do under your patent of 1854?

(Same objection.)

A. No. I do not, provided that in the event of their boiling in a open vessel they did not use the subsequent chemical treatment described in the patent; or if they boiled under pressure in a caustic

alkaline solution, they did not use that temperature which is necessary for the removal of intercellular matter which binds the true fibre together.

Q. 144. What is there in the patent of 1854 in relation to such temperature, as referred to in your last answer?

(Same objection.)

A. There is no definite temperature stated in the patent of 1854, because, from my then ignorance of patent law, I believed that from mentioning boiling under high pressure I was entitled to its use to any extent that I desired, believing that no one, at that time, had really pulped vegetable substances by boiling in alkaline solutions at a high pressure.

Q. 145. Were you not aware that hemp ropes had been boiled under pressure in alkaline solutions to make paper?

(Same objection.)

A. I was; but I had never seen and never heard of true pulping being effected on rope for paper-making purposes. The ropes being boiled in comparatively dilute solutions of alkali and lime to remove dirt, and certain portions of the intercellular matter, the fibre of this hemp-rope being still strongly cemented together by the intercellular tissue not removed by the boiling, to such an extent that the rag-engine had to be employed for a long time to tear up and open out the hemp fibre, the complete destruction of the intercellular matter being effected by the large quantities of bleach which such rope always requires.

Q. 146. In your answer to the 70th cross-interrogatory, you state that in taking out the reissued patent of 1863, it was intended that it should apply to all vegetable substances containing ligneous matter, and that you know of no vegetable production that does not
320 contain ligneous matter when it has arrived at maturity. Did you intend, in taking out your original patent of 1854, that it should apply to all such substances to be boiled in alkaline solutions, whether under pressure or in an open vessel?

(Same objection.)

A. I intended, in 1854, in taking out the patent, naturally to include such vegetable substances as I believed would produce paper pulp.

Q. 147. Knowing as you did, when you took out your patent of 1854, that straw paper was then being made by boiling straw in an alkaline solution, did you not intend to take your patent for making paper pulp from wood by first boiling the wood in a strong alkaline solution, whether under pressure or not, and then subjecting the damp shavings to the action of chlorine, or the compound of chlorine with oxygen, and then placing the material in a weak solution of caustic alkali; and was not the treatment in that order the invention for which you sought to obtain a patent?

Same objection.)

A. In taking out the patent In 1854, for making paper pulp from wood, et cetera, by first boiling the wood in a strong alkaline solution, whether under pressure or not, I did intend following the sub-

sequent process to a greater or less extent, according to the amount of alkali and pressure used in the first stage; but I believed that the best pecuniary result would be obtained by boiling with a moderate quantity of alkali under pressure, and the subsequent use of a considerable amount of chlorine. I am not aware that my knowledge of the fact that straw paper was being made by boiling straw in an alkaline solution had much weight with me, as I was not aware that the simple boiling of straw in an alkaline solution had been used for the manufacture of paper pulp, except for common yellow paper.

321 *Examination resumed.*

MARCH, 26*th*, 1867.

Present: counsel for respective parties.

Q. 148. Is your patent of 1854, or the reissue of 1863, for any particular quality of paper?

(Same objection.)

A. No, they were not.

R. 149. Had you any idea, when you applied for your patent of 1854, that you could have the right, under that patent, to prevent others in the United States from making paper from straw, manilla, hemp and flax, by boiling these materials in an alkaline solution without treating them "with caustic alkali, chlorine simple or its compounds with oxygen and alkali, in the order substantially as described" in your said patent of 1854?

(Same objection.)

A. When I applied for the patent in 1854, I believed that that patent would give me the right to prevent others in the United States, from making paper from straw, et cetera, by boiling these materials in an alkaline solution without treating them with caustic alkali, chlorine simple, or its compounds with oxygen and alkali, in the order substantially as described, provided that the vegetable substances were disintegrated by means of the boiling in an alkaline solution, which could only be done under pressure.

Q. 150. Please refer to your answer to the 106th interrogatory. If you, in 1853, made the discovery mentioned in the said answer, why did you not disclose the same in your patent of 1854, instead of stating therein as follows: "We find boiling in a solution of caustic alkali under pressure of considerable service. We do not claim this operation as a part of our invention?"

(Same objection.)

A. Because, at the time of my applying for the patent in 1854, I believed that no one had ever thought of using alkali in boiling under pressure, for the purpose of desintegrating vegetable substances. I thought the idea a perfectly novel scientific fact, and in my ignorance of patent matters at that time, I thought I only had to refer to
322 it to entitle me to its use for the above purpose, but as I knew that boiling under pressure, as a process, such as the boiling of cotton rags and waste, et cetera, under pressure, for the purpose of destroying the mordants of the dyes and grease and dirt and that

a small close boiler was well known as Papin's Digester, I used the words "we do not claim this operation as a part of our invention;" these words badly expressing the idea I wished to convey."

Q. 151. If you made the discovery which, in your answer to the 106th interrogatory, you say you did, why did you in your reissued patent No. 1,449, make the following statement: "Boiling in a solution of caustic alkali under pressure is of essential importance. By the words 'under pressure' is meant a pressure at, near, or above 300° Fahrenheit?" Why did you not state in that reissued patent what you have stated in your answer to the 106th cross-interrogatory, as follows: "For resinous woods a temperature of the solution of about 372° Fahrenheit was necessary for non-resinous woods a temperature of the solution of about 366°?"

(Seme objection.)

A. Because, in applying for the reissued patent No. 1,449, the words first quoted in the question appear to me to better cover the temperatures necessary for the disintegrating of vegetable substances when boiling in an alkaline solution, than if I had given definite temperatures, as I had found that the temperature necessary to effect this disintegration greatly varied with the character of the material under operation. I did not wish to confine myself to particular temperatures for any particular vegetable substance, as the age of these substances required varying temperatures.

Q. 151. With respect to the patent obtained by you and Mr. Watt, in England, referred to in your American patent of 1854, have you, or anybody else, ever done anything under that patent in England? Are any works now in operation there under that patent?

(Same objection.)

A. In 1855 or 1856 works were commenced and started under the auspices of Mr. Charles Watt, but owing to disagreements between him and the gentlemen who furnished the means, nothing
323 practical at that time was accomplished. Owing to Mr. Watt's great age the matter has not been able to be resuscitated, though various efforts have been made. To the best of my belief there are no works in operation, as I have not heard that they have been successful in effecting the necessary pecuniary arrangements.

Q. 153. Do you know that wood paper pulp is extensively manufactured in England to be mixed with rags?

(Same objection.)

A. I do not know that wood paper pulp, prepared by chemical means, is extensively manufactured in England to be mixed with rags, but I have heard that ground wood has been used in England for that purpose.

Q. 154. The wood paper pulp manufactured by the complainants is commonly mixed with rag pulp or some other material to strengthen it, is it not?

(Same objection.)

A. The wood paper pulp now manufactured at Royer's Ford is not mixed with any foreign material; that manufactured at Manayunk,

for newspaper, has, I believe, about 4 per cent. of rope; at least this is the quality I was told they were using when I was last there.

Q. 155. Do you think the pulp shown you, and marked defendant's Exhibit C, would require any admixture with rags to make good strong paper.

(Same objection.)

A. I believe such pulp, with proper rag-engine manipulation, could be made into a good quality of paper. I could not exactly say as to its strength until I had seen its behavior in the rag-engine.

Q. 156. If you consider the first claim in your reissued patent of 1863, No. 1,449, to include any invention except what you disclaimed in your patent of 1854, state what it is.

(Same objection.)

A. What I consider was claimed in the first clause of the reissued patent of 1863, No. 1,449, did not include any invention, except the use of boiling of vegetable substances in alkali, under pressure, as a process of preparatory process for the manufacture of paper from such vegetable substances.

Q. 157. Is not the second claim in the said reissued patent confined to a process of treating resinous woods?

324 (Same objection.)

A. The second claim refers to the process of treating resinous woods, but I do not understand that it is strictly confined to those woods.

Q. 158. By whose agency were the reissues in 1863, the reissued patents Nos. 1,448 and 1,449, obtained? Did Mr. Jenckes have anything to do with the applications for these reissues?

(Same objection.)

A. I consulted Mr. Jenckes during the application for the reissue of these patents, Nos. 1,448 or 1,449, during the year 1863. The patents were obtained in connection with myself, Mr. Ladd, and Mr. Keen. To the best of my recollection Mr. Jenckes was with me in Washington at the time I searched the Patent Office, and I advised with him upon the result of such search.

Q. 159. How do you make out that your claim of the use of the chemical processes, and in the order named in the English patent, is the same that you claim in your American patent of 1854, in which nothing is said about the use of sulphurous acid before the boiling in an alkaline solution?

(Same objection.)

A. In the patent of 1853 the compound sulphurous acid process was only a preparatory process and not an essential one, and I saw no reason for retaining it in the American patent of 1854.

Q. 160. Why did you omit from your American patent of 1854 the directions to boil the shavings of wood for some hours in water in the first stage, and then to pass a stream of sulphurous acid through the mass before treating the same with chlorine or chlorous acid, as directed by the English patent to be done before the boiling in alkaline solution?

(Same objection.)

A. Because I did not think the sulpherous acid process of sufficient value to take the place of the extra expense incurred in its use.

Q. 161. Do you consider that, notwithstanding the omission referred to in your last question, your American patent is for the same invention as that described in your English patent, in which
325 you claimed, as follows: "In the above processes we do not confine ourselves to the particular apparatus or utensils herein named, but claim the use of the chemical processes, and in the order herein stated?

(Same objection.)

A. I do; because the sulphurous acid process is only alluded to in the provisional specification; it is omitted in the complete specification.

Q. 162. What do you understand to be the invention described and claimed in Keen's patent, dated 16th June, 1863? Do you consider that the invention consists in connecting the man or feed-hole in the shell of the boiler, with the man or feed-hole through the diaphragm, by a perforated well or cylinder, as mentioned in the patent, and in the combination of the arrangement of the discharge pipe and valve with a boiler provided with such perforated diaphragm?

(Same objection.)

A. I consider that the invention consists in a boiler placed vertically with the diaphragm, discharge cock, substantially as described and arranged in the specification.

Q. 163. Is there such a perforated diaphragm and well in the vertical boilers which you saw at the defendant's works?

(Same objection.)

A. I did not see the interior of the boilers at defendant's works, and cannot therefore reply to the question.

Q. 164. Is there any, and if any, what difference between the arrangement of the discharge pipe and valve described in the said Keene patent, dated 16th June, 1863, and the discharge valve and cock described in Keen's patent, dated 15th September, 1859?

(Same objection.)

A. There is a difference between the arrangement of the discharge valve described in the Keen patent, dated June, 1863, and the discharge valve and cock described in Keen's patent, dated 13th September, 1859; but the model from which the description of the last patent, 1859, was taken, was merely a small tin model made by Mr. Keen, to illustrate the general principle of the boiler, and he does not in this patent confine himself to any particular form
326 of discharge valve. The difference between the two valves is merely mechanical, the one being a slide valve and the other a cone valve.

Q. 165. For what length of time have the complainants, and those under whom they claim, manufactured and sold paper or paper pulp by the process described in the Watt and Burgess patent, reissued in 1863?

(Same objection.)

A. The paper was manufactured by the compound process described

in the Watt and Burgess patent in the year 1854, but I believe not sold; it has been regularly sold in the market since 1856. The paper has been manufactured and sold by the complainants under the Watt and Burgess patent, inasmuch as the compound process described in that patent has been from time to time used; we do not generally use it. I should think that we must have used the compound process within six months after the time the complainants came into possession of that patent.

Q. 166. Is there any practical mode by which the paper-maker can determine the temperature of the liquid in which he boils vegetable substances under pressure, except by noting the steam-pressure in the pulping boiler, or in the feed-boiler, making due allowance in the latter case?

(Same objection.)

A. I am aware of none. I refer to a practical operation.

Q. 167. Please refer to Brande's Encyclopædia of Science, published in New York, in 1845, title, Steam Boiler, page 1166. now shown you, and to the table there exhibiting the temperature and corresponding pressure of steam, as determined by the experiments of the French academy, and state whether that table differs from any other table or scale of the French academy which you have seen.

(Same objection.)

A. I cannot at present recollect if there is any difference, as I very seldom refer to a French scale.

Q. 168. Refer to your answer to the 95th interrogatory, and state whether you find the scale of the French academy, as published in Brande's Encyclopædia, to be what you stated in your said answer you believed it to be.

(Same objection.)

A. I have examined my answer to the 95th interrogatory,
327 and it appears that the scale of the French academy, as published in Brande's Encyclopædia, is what I believed it to be.

Q. 169. Does not that table exhibit the temperature 212° to correspond with the pressure of one atmosphere, and is not the temperature 300° represented there by a pressure of between sixty-six and sixty-seven pounds to the inch?

(Same objection.)

A. In the table referred to, the table of 212° corresponds to the pressure of one atmosphere, and the temperature of 300° is represented by a pressure of between sixty-six and sixty-seven pounds; but this table is a translation, and I do not know how the atmospheric pressures correspond to the French mode of estimating them.

Q. 170. Please refer to the same book, page 1163, and see Dr. Lardner's table there. showing in one column the "total pressure in pounds per square inch, and in another column "the corresponding temperature." Does not that scale make sixty-six pounds pressure equivalent to a temperature of 302° Fahrenheit, calculating the atmospheric pressure which you supposed to be omitted in the French calculation?

(Same objection.)

A. I have referred to the said book, and find that the total pressure in pounds, per square inch of sixty-six pounds, is equivalent to a temperature of 302°, but in both of these tables it is the temperature of the steam, and not of the water, which is given. This table is not calculated according to the French method. In connection with this matter, great and numerous variations and errors have been committed by the various experimenters, owing to the want of care in permitting the pressures to rise before the previous pressure's true temperature is recorded by the thermometer. Very delicate apparatus is required to estimate this temperature, and a very slow order of experimenting.

Q. 171. Is this hand-book, called "Engineers' and Mechanics' Hand-Book," published by Harper & Brothers, New York, edited by Charles H. Haswell, the hand-book referred to by you in your answer to the 100th interrogatory? and is the table there given from experiments of the committe of the Franklin Institue, the table you
328 referred to? and is not the temperature of 298.50° represented there by a pressure of 4.5 atmospheres, and a temperature of 304.50° by 5 atmospheres? and is not 212° there represented by one atmosphere?

(Same objection.)

A. It is not the book which I referred to in my answer to that interrogatory; the table is not the one I referred to. A temperature 212° is there represented by one atmosphere, and a temperature of 298.5° by 4½ atmospheres; and a temperature of 304.5° by 5 atmospheres. This table also alludes to the temperature of the steam, and not of the water.

Q. 172. Please refer to Miller's Elements of Chemistry, published in New York, in 1864, and look at the table on page 260. Is not the temperature 291.2° represented there by by a pressure of 4 atmospheres; and is not the temperature 306° there represented by a pressure of 5 atmosphere; and is not 212° Fahrenheit there represented by a pressure of 1 atmosphere?

A. The temperature in the work referred to in the last interrogatory, of 291.2°, is there represented by a pressure of 4 atmospheres; a temperature of 306° by a pressure of 5 atmospheres, and 212° by a pressure of 1 atmosphere. This table also indicates the temperature of the steam, and not of the water.

Q. 173. In your answer to the 55th interrogatory, you state that the words "at, near, or about," were purposely used in the patent. Have you not misquoted the patent, and was not the word "above" instead of "about" purposely used, in order to include a pressure up to 500° Fahrenheit, which would be according to the scale of the French Academy, a pressure of 45 atmospheres, or about 675 pounds pressure. Did you ever use such a pressure?

(Same objection.)

A. In my answer to the 55th interrogatory, the words used by me, "at, near, or about," should have been "at, near, or above;" the word "above" was purposely used in order to include any necessary pressure that we might require, up to as high as 500°. We have never used such pressure.

Q. 174. Look at the paper, the New York Tribune, of date
329 August 21, 1865, marked defendants' Exhibit D 2, and say whether you consider it to be paper of fair quality and strength?

(Same objection.)

A. I have examined such paper, and consider it a paper of fair quality and strength, with the exception that it is rather hard and rattling, which generally indicates that much of the intercellular matter has been removed by bleaching powders.

Q. 175. Was Mr. Watt, who was the joint patentee with you in your patent of 1854, in the United States, when the applications were made for the two re-issues of that patent, in 1863?

(Same objection.)

A. He was not in the United States at that time.

Q. 176. Did he or you, on such applications, or either of them, make oath or affirmation that you were the original and first inventors or discoverers of the value and efficacy of the boiling of vegetable fibrous substances in an alkaline solution at, near, or above a temperature of 300° Fahrenheit?

(Same objection.)

A. I cannot remember, at the present time.

Q. 177. Have you, or has the said Charles Watt, at any time made such oath or affirmation, to be filed in the Patent Office?

(Same objection.)

A. I cannot remember, at this time, as to that fact.

Q. 178. Has any other person, to your knowledge ever made such oath or affirmation, to be filed in the Patent Office, in support of any or either of the applications for patents or reissues of patents, claimed by the complainants?

(Same objection.)

A. I cannot remember, at this date, as to that fact.

(Complainants' counsel here states that he now recalls the witness.)

Q. 179. Look at the instrument now shown to you and marked "Exhibit O, K. G. W., Examiner, &c.," and state whether the signature of said A. P. Harrison, subscribed thereto as witness, is genuine?

A. It is.

Q. 180. Look at the instrument now shown to you, and
330 marked by the examiner "Exhibit P, K. G. W., Examiner, &c.," and state whether you made oath to the facts therein stated, on the 13th day of September, 1858, and whether the same were true at that time?

(Objecton by defendants.)

A. I can answer to signing such an affidavit, but cannot say positively the day; but to the best of my belief, it was on the day mentioned in the interrogatory. The facts stated in the affidavit were at that time true.

Recross-examination.

By defendants:

Q. 181. In Exhibit P, no date appears when such affidavit purports to have been made. How do you fix the time when you say it was made?

A. Because, to the best of my belief, I signed it before Mr. Munchower, on the day which is attached, and from the fact that it had to be sent to the Patent Office in 1858.

Q. 182. Can you state, from your own knowledge or recollection, when the application for that reissue of 1858, was made?

A. I cannot, except from the date on the affidavit and the date of year of the reissue.

HUGH BURGESS.

Sworn before me, on the days which appear in the body of this deposition, and subscribed this 26th day of March, 1867.

KENNETH G. WHITE,
Examiner, &c.

Adjourned to March 27th, 1867, at 11 a. m.

MARCH 27*th*, 1867.

Present: Counsel for respective parties.
Adjourned to 28th inst., at 11 a. m.

Examination resumed.

331 MARCH 28*th*, 1867.

Present: counsel for respective parties.

George P. Nelson, produced and sworn on the part of the complainant, testified as follows:

Q. 1. What is your name, age, residence, and occupation?

A. My name is George P. Nelson. I am in my fifty-first year; residence, Scarsdale, in the county of Westchester, and my occupation is that of a lawyer.

Q. 2. Have you ever seen a power-of-attorney executed by Charles Watt, appointing John Watt his attorney to sell a patent for the manufacture of paper from wood?

(Objection by defendants.)

A. I saw such a power-of-attorney in the year 1854, purporting to be executed by Charles Watt, and to have been acknowledged by him before George N. Saunders, consul of the United States for London and dependencies, with the consular seal attached to the certificate of acknowledgment. That power-of-attorney was, at that time, in possession of John Watt.

Q. 3. Do you remember the contents, or the substance of the contents, of said power-of-attorney? If yea, state the same fully and particularly.

(Objection by defendants.)

A. I recollect the substance of the contents of that power-of-

attorney. The substance of it was, that Charles Watt constituted and appointed John Watt his attorney, giving him power and authority to sell his interest in a patent for the manufacture of paper from wood, ordinarily termed the wood paper patent, and his attorney, in case of sale, to make, execute, and deliver, the necessary instrument, assignment, or transfer of the same; and also giving to him, John Watt, a power of substitution and revocation.

Q. 4. Was the said power-of-attorney sealed?

(Objection by defendents.)

A. It was.

Q. 5. Did you know the said John Watt, in 1854?

(Objection by defendants.)

A. I did; and became very well acquainted with him.

332 Q. 6. Do you know whether the said John Watt did any thing? and if so, what, under said power-of-attorney, as the attorney of said Charles Watt, after the execution of said instrument and before substituting anybody in his place?

(Objection by defendants.)

A. I know that he made negotiations for the sale of the interest of Charles Watt, in that patent, but do not know that any negotiations were concluded before he left for Europe, and before he substituted an attorney in his place.

Q. 7. Look at the instrument now shown you, and marked by the examiner "Exhibit O, K. G. W., examiner, &c.," and state whether you know A. P. Harrison, whose name is subscribed as witness thereto.

(Objection by defendants.)

A. Yes.

Q. 8. Where is the said A. P. Harrison now?

(Objection by defendants.)

A. He is in the city of New Orleans, and has lived there since, prior to 1860.

Q. 9. Have you ever seen the said A. P. Harrison write; and are you acquainted with his handwriting?

(Objection by defendants.)

A. I have seen him write very often, and am acquainted with his handwriting.

Q. 10. Is his signature as a subscribing witness to said instrument genuine?

(Objection by defendants.)

A. It is the genuine signature of A. P. Harrison.

Q. 11. Were you present at the execution of said instrument? If yea, did you see the execution of the same, and did you see the said John Watt sign said instrument?

(Objection by defendants.)

A. The instrument was drawn in my office. The date of the month is in my handwriting. It was executed at my office by John Watt, and in my presence, and Mr. Harrison was with him there and subscribed it as witness, also in my presence. I saw John Watt sign it, and I saw Harrison subscribe his name as a witness to it.

Q. 12. Did you see the power-of-attorney mentioned in said instrument at the time of such execution of the same?

333 (Objection by defendants.)

A. I did, and compared it with the dates mentioned in this instrument executed by John Watt.

Q. 13. Examine the paper writing now shown to you and marked by the examiner "Exhibit Q, K. G. W., examiner, &c.," and state whether the same is a correct copy of the said original instrument now shown to you and mentioned in the preceding seventh interrogatory.

(Objection by defendant.)

A. It is. I have examined and compared it with the original, and find it a correct copy.

Counsel for complainant's here offers in evidence the sworn copy, marked Exhibit Q.

Q. 14. Do you know Hugh Burgess, of Royer's Ford, Pennsylvania? Have you ever seen him write, and are you acquainted with his handwriting?

A. I do know him and have known him for twelve to fifteen years past; I have seen him write, and am acquainted with his handwriting.

Q. 15. Do you know Frederick B. Houghton, of England, formerly of the city of New York? Have you ever seen him write? and are you acquainted with his handwriting?

A. I do know him, and have known him for a good many years. I have seen him write very frequently, and am well acquainted with his handwriting.

Q. 16. Did you prepare an assignment to the said Frederick B. Houghton of letters patent of the United States, issued to Watt and Burgess for the manufacture of paper from wood?

(Objection by defendants.)

A. I did prepare such an assignment. Mr. Houghton was my client at the time.

Q. 17. Do you remember the contents or the substance of the contents of said assignment? If yea, state the same fully and particularly.

(Objection by defendants.)

A. I do recollect the substance of that assignment. For the consideration of twenty-five thousand dollars, Hugh Burgess and Charles Watt assigned and transferred to Mr. Frederick B. Houghton

334 letters patent, granted to them by the United States, for certain improvements in the manufacture of paper from wood, and all their right, title, and interest in and to the same, and all matters growing thereout absolutely. The instrument was dated in November 22d, [November,] 1854. It also gave the date of the letters patent, which was the 18th July, 1854.

Q. 18. Were you present at the execution of said assignment?

(Objection by defendants.)

A. I was.

Q. 19. Did you see the execution of said assignment?

(Objection by defendants.)

A. I did.

Q. 20. By whom was said assignment executed?

(Objection by defendants.)

A. It was executed by Charles Watt, by his attorney, Hugh Burgess, and by Hugh Burgess individually.

Q. 21. Were the signatures of said Hugh Burgess to said instrument individually, and as the attorney of said Charles Watt, genuine?

(Objection by defendants.)

A. They were the genuine signatures of Hugh Burgess. I was commissioner of deeds at the time, and it was acknowleded before me, by Hugh Burgess, at that time, as attorney for Charles Watt, and for himself individually, and my certificate of acknowledgment was added to it.

Q. 22. Was said assignment sealed?

(Objection by defendants.)

A. Yes, sir; it was.

Q. 23. Did you see the delivery of said assignment to said Frederick B. Houghton?

(Objection by defendants.)

A. I did, sir; it was done immediately after the execution of it by Mr. Burgess.

Q. 24. Were the letters patent mentioned in said assignment delivered at the same time to the said Frederick B. Houghton?

(Objection by defendants.)

A. Yes, sir; they were. The letters patent were left in my possession by Frederick B. Houghton, for safe keeping, for some
335 length of time afterwards, but for how long I cannot state.

Q. 25. Did you see the said Frederick B. Houghton pay at [at] that time to the said Hugh Burgess the consideration expressed in said assignment?

(Objection by defendants.)

A. I did.

Q. 26. Have you made any search for said assignment? If yea, with what success?

(Objection by defendants.)

A. I have made very diligent search in my office among all my papers, and I have made such search several times, but have never been able to find it.

Q. 27. State if you know who last had possession of said assignment, and whether the same is now in existence.

(Objection by defendants.)

A. The last that I recollect positively about the possession of that assignment, it was in my possession in my safe at my office; my office was then at 70 Wall street. It has gone from my possession, or at least I cannot find it; whether it is in existence I cannot say; I do not know. I moved my office five years ago from 70 Wall street to 55 Liberty street, where it is now. The safe in my office in Wall street was built in the wall and belonged to the building, and when I moved I had to move those papers from that safe, and my only

solution as to the loss of that paper is, that it may have been lost in moving those papers from Wall street to Liberty street. I lost a number of papers at that time.

Q. 28. Did the said Frederick B. Houghton do anything, to your knowledge, and if so what, after the execution of said assignment, as the owner of said letters patent and property under said assignment?

(Objection by defendants.)

A. I know that he made sundry experiments under the patent in making paper, and finally he made a sale and transfer of it to William F. Ladd and Morris L. Keen.

Q. 29. Look at the instrument now shown to you and marked "Exhibit R, K. G. W., examiner, &c.," and state whether your signature to the same as a subscribing witness to the execution thereof is genuine, and whether you saw the said Frederick
336 B. Houghton execute the same, and whether his signature thereto is genuine?

A. My signature as a witness is genuine; I saw Frederick B. Houghton execute the same and sign his name, and both signatures are genuine.

Q. 30. Read the recital in the instrument mentioned in the last interrogatory now shown to you, and state whether the same is true to your own knowledge.

(Objection by defendants.)

A. I had in my possession the original patent granted by the United States to Watt and Burgess. I also had at one time in my possession the power of attorney executed by Charles Watt to John Watt, for the purpose of drawing the substitution of Hugh Burgess as attorney. I also prepared and had in my possession the assignment of the letters patent by Charles Watt and Hugh Burgess to Frederick B. Houghton. And after the assignment to Frederick B. Houghton I know of an agreement between Frederick B. Houghton and William F. Ladd and Morris L. Keen, by which Ladd and Keen became entitled to have an assignment of the letters patent from Houghton. In carrying out that agreement between them this assignment, Exhibit R, was drawn and executed and delivered.

Q. 31. What did you do with the power-of-attorney of Charles Watt, mentioned in your last answer?

(Objection by defendants.)

A. Immediately on executing the substitution of Hugh Burgess as attorney in his place, John Watt took it with him.

Q. 32. At the execution of the instrument, Exhibit R, did you see the indenture therein recited as executed by Charles Watt and Hugh Burgess delivered to the said William F. Ladd or Morris L. Keen?

(Objection by defendants.)

A. I have not any recollection of seeing it then at all.

Q. 33. Examine the paper-writing now shown to you and marked by the examiner "Exhibit S, K. G. W., examiner, &c.," and state whether the same is a correct copy of the original instrument, Exhibit R, now shown to you?

(Objection by defendants.)

A. I have examined and compared it with the original in-
337 strument, marked Exhibit R, and it is a correct copy of it, and the whole of it.

Counsel for complainants here offers in evidence the sworn copy, marked Exhibit S.

GEORGE P. NELSON.

Subscribed and sworn to before me this 28th day of March, 1867.
KENNETH G. WHITE, *Examiner, &c.*

William F. Ladd produced and sworn on the part of the complainants, deposes and saith:

Q. 1. What is your name, age, residence and occupation?

A. I am fifty-seven years old. I reside at Tarrytown, in Westchester county; am a dealer in watches and jewelry.

Q. 2. Do you know Frederick B. Houghton, now of England, formerly of the city of New York?

A. I do. I have known him for about twenty-five years.

Q. 3. Read the instrument now shown to you and marked "Exhibit R, K. G. W., examiner, &c.," and state whether you are the person named therein as one of the assignees, and whether the facts therein recited are true, to your own knowledge.

(Objection by defendants.)

A. I am the person named therein. I have read the recital, and the facts stated therein are true.

Q. 4. Were you present at the execution of said instrument? If yea, did you or the Morris L. Keen mentioned in said instrument, to your knowledge, then receive from the said Frederick B. Houghton the indenture recited in said instrument?

(Objection by defendants.)

A. I do not recollect whether I was present.

Q. 5. Did you or the said Morris L. Keen, to your knowledge, ever receive from said Frederick B. Houghton, or have possession of the indenture from Charles Watt and Hugh Burgess to Frederick B. Houghton, recited in said instrument?

(Objection by defendants.)

338 I never did receive it or have possession of it, and Mr. Keen never did, to my knowledge.

Q. 6. Do you not remember whether the assignment now shown to you, and marked "Exhibit R, K. G. W., examiner, &c.," was delivered to you or to the said Morris L. Keen? If so, to which one of you was the same delivered?

(Objection by defendants.)

A. It was delivered to me. I do not recollect whether Mr. Keen was present or not.

Q. 7. Did the said Frederick B. Houghton do anything, to your knowledge, and if so, what, as the owner of the letters patent recited in said instrument, Exhibit R, and of the property granted by said letters patent under the assignment to him from Charles Watt and Hugh Burgess, recited in said instrument, after the execution of said

assignment and before he disposed of his interest in said letters patent?

(Objections by defendants.)

A. Frederick B. Houghton, as the owner of said letters patent, engaged said Morris L. Keen, and erected works and a factory at Gray's Ferry, West Philadelphia, for the purpose of making pulp from wood under the said patent. He offered said patent for sale, and endeavored to form a company under said patent. This was about January or February, 1855.

Q. 8. Did you and said Morris L. Keen do anything, and if so, what, as the owners of said letters patent and property, under said assignment thereof from Frederick B. Houghton, after the execution of the same?

(Objection by defendants.)

A. We erected works at Royer's Ford, Pennsylvania, for the purpose of manufacturing paper and pulp under said patent, which works have been in operation for many years, and are in operation at this time.

WILLIAM F. LADD.

Subscribed and sworn to before me this 28th day of March, 1867.

KENNETH G. WHITE,
Examiner, &c.

339 In the Circuit Court of the United States for the eastern district of New York.

THE AMERICAN WOOD PAPER COMPANY
vs.
THE FIBRE DISINTEGRATING COMPANY.

Testimony of Alfred K. Hall, a witness on behalf of complainants, taken pursuant to rule, order, and notice, before Samuel W. Peckham, special examiner, Saturday, the 23d day of February, 1867, at 10 o'clock, at the office of the American Wood Paper Company, No. 28 Westminster street, in the city of Providence.

Alfred K. Hall, a witness on behalf of the complainants, having been duly sworn, testifies and says:

Q. 1. What is your name, age, residence, and occupation?

A. Alfred K. Hall; forty-six years; residence city of Providence; occupation, book-keeper.

Q. 2. Do you know Benjamin Buffum, of the city and county of Providence, State of Rhode Island?

A. I do.

340 Q. 3. Look at the instrument now shown to you and marked by the examiner Exhibit D, and state whether your signature to the same as a subscribing witness to the execution thereof is genuine, and whether you saw the said Benjamin Buffum execute the same, and whether his signature thereto is genuine.

A. My signature is gennine. I saw Benjamin Buffum execute the same, and his signature is genuine.

Q. 4. Examine Exhibit D, annexed to the complainants' bill of

complaint, and state whether the same is a crrect copy of the original instrument now shown you.

A. It is.

Q. 5. Look at the instrument now shown to you and marked by the examiner Exhibit K, and state whether your signature to the same as a subscribing witness to the execution thereof is genuine, and whether you saw the said Benjamin Buffum execute the same, and whether his signature thereto is genuine.

A. My signature is genuine. I saw Benjamin Buffum execute the same, and his signature is genuine.

Q. 6. Examine Exhibit K, annexed to the complainants' bill of complaint, and state whether the same is a correct copy of the original instrument now shown to you.

A. It is.

Q. 7. Look at the instrument now shown to you and marked by the examiner Exhibit O, and state whether your signature to the same as a subscribing witness to the execution thereof is genuine, and whether you saw the said Benjamin Buffum execute the same, and whether his signature thereto is genuine.

A. My signature is genuine. I saw Benjamin Buffum execute the same, and his signature is genuine.

Q. 8. Examine Exhibit O, annexed to the complainants' bill of complaint, and state whether the same is a correct copy of the original instrument now shown to you.

A. It is.

Q. 9. Look at the instrument now shown to you and marked by the examiner Exhibit P, and state whether your signature to the same as a subscribing witness to the execution thereof is genuine,
341 and whether you saw the said Benjamin Buffum execute the same, and whether his signature thereto is genuine.

A. My signature is genuine. I saw Benjamin Buffum execute the same. and his signature is genuine.

Q. 10. Examine Exhibit P, annexed to the complainants' bill of complaint, and state whether the same is a correct copy of the original instrument now shown to you.

A. It is; with this exception that the following clause, "and in and to letters patent granted to me on the 16th day of June, A. D. 1863, for an improved boiler for making paper pulp," is in the original, but is not in the copy marked Exhibit P.

Q. 11. Do you know, or can you set forth, any other matter or thing which may be a benefit or advantage to the parties at issue in this cause, or either of them, or that may be material to the subject of this your examination, or the matters in question in the cause? If yea, set forth fully and at large in your answer.

A. I know nothing further.

ALFRED K. HALL.

Subscribed and sworn to this 23rd day of February, 1867, before me.

SAMUEL W. PECKHAM,
Examiner.

342 *M. A. C. Mellier's patent of May* 26, 1827.—*Petition, correspondence, &c., from the records of the United States Patent Office.*

To all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the files of this office of the file wrapper and contents in re, the letters patent granted M. A. Chas. Mellier, May 26, 1857, No. 17,387.

In testimony whereof, I, T. C. Theaker, Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed this first day of November, in the year of our Lord one thousand eight hundred and sixty-seven, and the independence of the United States the ninety-second.

(Signed) T. C. THEAKER.

{ SEAL OF THE PATENT OFFICE OF THE UNITED STATES OF AMERICA. }

NEW YORK, *September* 30, 1856.

To the honorable the Commissioner of Patents:

SIR: I send you the papers, model, and power-of-attorney relating to A. Mellier's application for a patent, and I claim for it the privilege granted by law of an immediate examination.

Foreign patents have been granted to A. Mellier in France, in the name of Ladet, August 7, 1854; in England, in A. Mellier's name, May 2, 1855, and sealed October 26, 1855.

343 I send you the papers received from France, which I have reason to believe to be a copy of the English patent; and of also a new specification and drawing, which I wish to substitute to the first. I hope you will find them drawn more in accordance with the directions of your office.

Respectfully, yours,

V. BEAUMONT,
96 *Walker street.*

Endorsed, received, and filed October 3, 1856.
L. F. W. 3751—1.

To the Commissioner of Patents:

The petition of Marie Amidee Charles Mellier, of Paris, in the Empire of France, respectfully represents: That your petitioner has invented an improvement in the manufacture of paper, which, he verily believes, has not been known or used prior to the invention thereof by your petitioner. He, therefore, prays that letters patent of the United States may be granted to him therefor, vesting in him and his legal representatives the exclusive right to the same, upon the terms and conditions expressed in the act of Congress in that case made and provided, he having paid three hundred dollars into the treasury, and complied with other provisions of the same act.

And he hereby authorizes Victor Beaumont, of New York city, to act as his attorney in presenting this application, altering or withdrawing the same as the case may require, and to receive the patent when granted.

London, July the 21st, 1856.

AM. MELLIER.

LONDON, COUNTY OF MIDDLESEX, ENGLAND.

On this 22d day of July, 1856, before the subscriber, consul of the United States, personally appeared the within-named Marie Amedee Charles Mellier, and made solemn oath that he verily believes himself to be the original and first inventor of the improvements in the manufacture of paper herein described, and that he does not know or believe the same was ever before known or used, and that he is a citizen of France.

AM. MELLIER.

344 CONSULATE OF THE UNITED STATES OF AMERICA, LONDON.

I, Robert P. Campbell, consul of the United States of America for London and the dependencies thereof, do hereby make known and certify that, on the day of the date hereof, before me personally appeared and came Marie Amidee Charles Mellier, who subscribed the foregoing affidavit in my presence, and then and there made solemn oath to the truth thereof.

In testimony whereof, I have hereunto set my hand and affixed my seal of office in London this twenty-seoond day of July, A. D. 1856, and in the eighty-first year of the independence of the said United States.

[CONSULAR SEAL.] ROBERT P. CAMPBELL.

Endorsed: Received and filed October 3, 1856.—L. F. W.

To all whom it may concern:

Be it known that I, Marie Amidee Charles Mellier, of Paris, in the Empire of France, have made an invention for an improvement in the manufacture of paper, and I do hereby declare that the following is a full and exact description:

The invention has for its object a peculiar process for the treating of straw and other vegetable fibrous materials requiring like treatment preparatory to the use of such fibres in the manufacture of paper; and the improvement consists in subjecting straw or such other fibrous materials to a pressure of at least seventy pounds on the square inch when boiling such fibrous matters in a solution of caustic alkali. For this purpose the straw or fibrous matters are cut into short lengths, soaked in warm water and washed. They are then placed in a suitable boiler, and I use for such purpose a rotary boiler provided with a coil or coils of steam pipe for the purpose of heating the contents; and I prefer that the boiling should be carried on at a temperature to produce at or about eighty pounds on the square inch in the boiler where are the fibrous materials to be acted

upon. But so high a temperature is not absolutely necessary, for I have found by experiment that it is essential that a temperature equivalent to seventy pounds on the square inch must be employed.

The quantity of alkali used is at the rate of about 16 per
845 cent. of caustic soda or potash of the straw or fibrous substance under process. The fibres may then be bleached by the use of a comparatively small quantity ef bleaching powder or chloride of lime.

To enable others skilled in the art to make and use my invention, I will proceed to describe more fully the manner of using the same:

The straw or other fibrous material requiring a like process to prepare the same for the paper manufacture, is first, as heretofore, to be cut in a chaff-cutting or other machine into short lengths, and to be freed from knots, dirt, and dust, and then steeped for a few hours in hot water. The straw or fibrous materials and a weak solution of caustic alkali are then to be placed in a suitable close boiler heated by steam, as hereafter explained, and the heat is to be raised to such a degree as to attain and maintain for a time a pressure internally of the boiler equal to or exceeding seventy pounds on the square inch, that is, about 310° of Fahrenheit, by which means a considerable saving of the alkali, as well as time and full results, as compared with the means of using a hot solution of caustic alkali as now practiced in preparing straw and other fibres for paper makers.

The boiler employed for the purpose and the manner of heating it by steam may be varied; but 1st, it must have a rotary motion, either on its long or on its small axis, by means which are very well known; and 2d, I prefer not to send the steam directly into the liquid in which the materials are immersed, but to pass it either in a jacket around the boiler, or through a coil or a system of steam pipes inside of it, so that the steam does not mix with the caustic alkaline solution in the middle portion of the boiler, but is kept separate, and does not, therefore, in condensing, dilute the caustic alkaline solution used.

The plan of construction of the boiler I should recommend would be, if the boiler is to rotate vertically, or on its small axis, as very well known, to cover it with a jacket, so that the steam could circulate from one end to the other between the two plates; or rather if it is to revolve horizontally or upon its long axis, as is equally very well known, to fix near each end of the boiler, and inside of it, a diaphragm or partition, which partitions are connected together by numerous tubes, which are arranged in a circle near the outer circumference of each partition. By this arrangement the steam
346 is introduced through the hollow axis at one end of the boiler, and it passes through the steam pipes, and thence into the compartments at the other end of the boiler, where it and the condensed steam is conveyed away, as is well understood, through the other hollow axis. In adopting the plan of not sending directly the steam into the boiler, I found the three following advantages:

1st. Not to dilute, as I have already said, the alkaline solution;

2dly. To avoid the trouble of having sometimes the end of the steam pipe in the boiler choked with straw, and to prevent, in case that by one cause or another the pressure in the steam boiler would fall under the degree of the pressure in the straw boiler, the priming of the first by the second, viz, the absorption of straw and alkaline solution from the straw boiler into the steam boiler; 3dly. The greater facility of cooling the straw boiler when the pressure has been maintained for a sufficient length of time by means of turning off the steam at one end, letting it at the other end out of the jacket or of the coils or steam pipes just described, and getting through the same a stream of cold water, which at the same time that it cools the mass furnishes a quantity of cold water which can be received in convenient vessels, and will be found very useful for washing the straw or other fibrous material after boiling.

By means of submitting the straw or other fibrous materials to a pressure of between seventy to eighty-four pounds on the square inch inside the boiler, I can reduce considerable the proportion of alkali, and the solution which I prefer to use is to be from two to three degrees of Beaume, or of a specific gravity of from 1.013 to 1.020, and at the rate of about seventy gallons of such solution to each cwt. of straw or other fibrous vegetable matters requiring like treatment.

The boiler is to be filled with straw and alkaline solution, and then closed fluid and steam tight. The boiler is made to revolve slowly, say about one or two revolutions per minute, and the steam is to be admitted. I find it desirable to keep up the heat and pressure during about three hours after the pressure above mentioned has been obtained, when the process of boiling is complete. A steam gauge properly fixed upon the boiler will enable one to ascertain when the pressure has obtained the required degree.

When the apparatus and the fibres under process has been cooled by the means hereinbefore mentioned, or rather when the
347 pressure has been reduced to nothing, I open the man-hole of the boiler, empty the materials in suitable vessels, and wash them first with hot water, then with cold water, until the liquor runs perfectly clear. I then steep the fibres for about an hour in hot water, acidulated with a quantity of sulphuric acid equal to about two per cent. of the weight of the fibres under process, and finally the washing is completed with cold water. The straw or fibre may then be bleached in the ordinary manner, and it will be found to be accomplished by a comparatively small quantity of lime.

Having thus described the nature of my said inveution, and the manner of performing the same, I would have it understood that I do not claim the general use of caustic alkaline solutions, nor the employment generally of a close boiler for boiling straw or other vegetable fibrous substances.

But what I claim is the subjecting straw or other vegetable fibrous substances to a boiling process in a weak solution of caustic alkali under considerable pressure, such as herein described.

AM. MELLIER.

Witnesses—ALLERENE, E. MARZI.

Received and filed October 3d, 1856.—L. F. W. 3,751.

"9TH OCTOBER, 1856.

"Upon comparing the specification of your application for patent for the manufacture of paper, as originally drawn up by you in Paris, with that prepared by your attorney in New York, it appears that the alleged inventions described and claimed in the respective specifications are not identical. The oath annexed to your original specification would, therefore, not apply to your amended specification, which is consequently returned for the supply of this deficiency.

Lest, however, you should by this point of formality be induced into error as to the light in which your two specifications are considered by this office, you are further informed that your original specification is drawn up in full accordance with the rules of this office,
348 and may, if so expressly desired by you upon return of the papers, be examined at once for the final decisions of your application. Should, you, however, desire to have your case examined upon the specification herewith returned, there would, beyond the formality of an oath, be necessary also, although a division of subjects, the process embraced by your first claim constituting one, and the boiler embraced by your second claim constituting another distinct subject of patentability, and which could not be claimed under one and the same fee.

M. A. CHAS. MELLIER,
Care of V. Beaumont, No. 96, Walker street, New York.

Endorsed: Office to Charles Miller. 9th October, 1856. 3752–2.

NEW YORK, *October 10th*, 1867.

To the honorable the Commissioner of Patents:

SIR: Mr. Mellier's interest is to have his invention decided upon as soon as possible; in consequence, I wish you to examine at once, as offered, the original specification.

The second specification, after striking out claim No. 2, is meant to be a more complete description than the first. Please tell me if it will be kept in your records.

Respectfully yours,

V. BEAUMONT, 96 *Walker.*

I should like to be enlightened on one point; if I had stood by the second specification, who was to take the oath required, Mr. Mellier, who is in England, or I?

I here return the papers.

Endorsed: M. A. Chs. Mellier, to office. Filed 15 Oct., '56. 3,751–7.

OCTOBER, 1856.

In answer to yours of the 10th inst., you are informed that your application for letters patent for alleged improvement in the manufacture of paper will be examined forthwith upon your origi-
349 nal specification. The second specification, unless requested by you otherwise, will remain on file in the office.

If you had stood by the second specification, the oath would have be taken by you, personally, in England, as there is no law in patent cases making an exception from the common law; that oath cannot be made by attorney.

M. A. CHAS. MELLIER,
Care of V. Beaumont, No. 96 Walker street, N. Y.

Endorsed: Office to M. A. C. Mellier. 18 Oct., '56.

U. S. PATENT OFFICE, 22*d Oct.*, 1856.

SIR: The claim of your application for a patent for alleged improvement in preparing paper pulp from straw or its equivalent, has been duly examined, and for reasons and reference given the claim is refused.

The patent of Geo. Spofford for a rag-boiler, granted in 1840, and reissued in 1850, extended to 1854, covers nearly the whole body of your claim, as you will perceive by inspection. So far as perceived, there is nothing left for you but the use of the alkaline solution, provided with or contained in a compartment separate from that which conveys the steam heat. If you choose to amend so as to restrict yourself to such devises, and they prove to be new, then such claim may be admitted.

The specifications returned herewith for further action.

Respectfully,

M. C. MELLIER,
Care of V. Beaumont, 96 Wall street, New York.

Endorsed: Office to Mellier, 22d October, 1856. 3,751–5.

To all whom it may concern:

350 Be it known, that I, Marie Amidée Charles Mellier, of Paris, in the empire of France, have made an improvement in the manufacture of paper, and do hereby declare that the following is a full exact description thereof, reference being had to the accompanying drawings, and to the letters of reference thereon.

My improvement has for its object the treating of straw and other vegetable fibrous materials preparatory to the use of such fibres in the manufacture of paper, and it consists in boiling said substance in a solution of caustic soda, under considerable pressure.

To enable others skilled in the art to make my invention, I will proceed to describe its construction and operation. The straw or other fibrous material is first cut into short lengths of about one inch, in a chaff-cutter or other machine. 2d. It is freed from knots, dirt, and dust in a smut or other machine. 3d. It is steeped for a few hours in hot water. In the meantime a solution of caustic alkali has been prepared in the following manner: in an iron tub full of warm water a quantity of lime is thrown, and the mixture is stirred so as to make the water dissolve the lime; then carbonate of soda, placed in a wire basket, is plunged into the solution of lime, and is moved in it. The

effect, according to the law of Bertholet, is that the carbonic acid of the carbonate of soda leaves the soda and combines with the lime, forming a carbonate of lime that precipitates to the bottom of the tub, when caustic soda remains dissolved in the water. After allowing time for the mixture to settle, the clear solution of caustic soda is decanted, by means of a syphon, into a another vessel, and the carbonate of lime is thrown away, or may be revived by burning for another operation.

The theoretical formula of the operation is : $CaO + CO2\ NaO + HO = CO2,\ CaO + NaO + HO$.

The proportions for the manufacture are one hundred pounds of lime for two hundred pounds of carbonate of soda · the quantity of water in a tub is indifferent, since, when the caustic solution is made, it s brought to a proper degree by adding water. The degree which I prefer is from two to three Beaumé's areometer, and at the rate of sixty-two gallons of such solution for every one hundred pounds of straw or other fibrous substances, which is equivalent to sixteen of soda for a hundred of straw. Much care must be taken in
351 preparing this solution, to precipitate the whole of the lime, as a very small quantity of the last-named substance mixed with the liquor is sufficient to render the bleaching impracticable.

The fourth operation is to take the straw from the water and to place it with a weak solution of caustic alkali in a closed boiler made in such a manner that the contents may be heated, the heat is then raised to 310° Fahrenheit or more, and the boiling is continued for three hours at that temperature. It will be known that the right temperature has been reached, when a steam guage attached to the boiler will indicate a pressure of seventy to eighty pounds ins de the boiler.

The boiler which I prefer is the one represented in the drawing ; it consists of an ordinary rotary boiler modified as follows :

Two steam chambers, one at each end, are separated from the centre part of the boiler, by partitions A B and C D and these steam chambers are made to communicate by steam pipes F G, F′ G′, &c., running through the boiler. A standing pipe H I is made to reach the lowest point of one of the steam chambers, and through it the water produced by the condensation of the steam is pressed out. When the boiler has been filed with straw and the solution of caustic soda, the man-holes are closed, steam is let through journal K, and the boiler is made to revolve slowly in the usual way.

The steam introduced will, by condensing in the pipes F G, heat the mixture inside the boiler, and the opening of pipe H I will be regulated by a cock, so as to let the water of condensation out and not the steam.

The fifth operation is to cool the fibres, to wash them, and to free them entirely from the alkali. The cooling is done by making a stream of water run through the pipes F G instead of steam, thus procuring at the same time a supply of clear water. The washing is done by emptying the fibres into a drainer and pouring on it first warm water, then cold water, till it runs out clear; said washing could also be made

in the boiler itself. To free the fibres from alkali, they are steeped one hour in hot water, acidulated with a quantity of sulphuric acid equal to about two to three per cent. of the weight of the fibres, and finally they are washed with cold water; the fibres are then ready to be bleached in the usual way, and it will be found to be accom-
352 plished by a comparatively small quantity of chloride of lime, that is to say, less than one-half the quantity usually required. Besides reducing largely by this new process of treating straw the quantity of chemicals, I find also a saving of sixty-six per cent. on fuel, of twenty per cent. on labor, and of twenty-five per cent. on the cost of the apparatus.

Having thus described my invention I wish it to be understood that I do not confine myself to the numbers mentioned or to the apparatus described. I have found that the degree of solution, the quantity of solution, the temperature at which it is used, and the time during which it is applied, are bound together in such a way that a saving on one may be made at the expense of the others ; for example, if sixty gallons of solution at three degrees for a hundred pounds of straw produced a good result, a quantity of ninety gallons of solution at two degrees will give also a good result. '

I have also found that a high degree and a short time will produce a paper less soft and pliable than the reverse; consequently the degree of the liquor, its temperature, quantity, and time of action, will have to be slightly varied according to the quality of the materials acted upon and that of the paper wanted.

It is also clear that the more the fibres are manipulated before boiling, the more easy that operation is performed, and that if straw was softened by exposure in the fields or other processes, less soda would be required for boiling; and, finally, though I have adopted the plan of boiling in a rotary boiler, modified as described, I know that it may be done by other arrangements.

A worm in a rotary boiler would be a good substitute for my pipes and partitions, when the rotary boiler is already built.

I could use an ordinary boiler, and send steam directly into the mixture. This plan, weakening the liquid, is not as good as the process described, but nevertheless would do. A stationery boiler over a fire could also be used, provided it is closed steam-tight, and some means of stirring be found.

Instead of pipes, or a worm inside a rotary boiler, a jacket could be put outside, and steam introduced between it and the boiler.

I do not claim the use of caustic soda or potash free from
353 any mixture of lime, nor the boiling fibres in a closed rotary or other closed boiler under a high pressure.

But what I claim as my invention, and desire to secure by letters patent is—

1st. Boiling straw or other fibrous vegetable substances for the manufacture of paper in a solution of caustic soda or potash, without any admixture of lime, in a closed boiler under a high pressure; and—

2d. An improvement in the common rotary boiler, in partitioning

the ends and connecting them by pipes for the purposes of boiling, without weakening the liquors by the water arising from condensation.

A. MELLIER.

Witnesses—
P. COUVIER,
C. S. BUCHANAN.

Endorsed: Received and filed, October 30, 1866. Cancelled 15th October, 1856.

October 31, 1856.

"To the Honorable Commissioner of Patents:

"SIR: Your letter of the 23d inst., having been misdirected to Wall street instead of Walker street, has reached me but yesterday.

"You refuse to admit Mellier's claim, such as it is, conflicting with that of J. Spofford. I have examined this last, and I here submit my views of the case.

"G. Spofford, in 1840, conceived the plan of a rotary boiler for boiling stuff under a high pressure, preparatory to making it into paper. It was found to give good results, and is used by paper makers to boil their rags in the ordinary liquors, and boil straw to make straw boards and wrapping-paper, that is, yellow stuff.

"They went on this way till 1852; at that time a patent was issued to Coupier & Mellier to make white paper from straw. Two paper mills were built in the United States upon that plan, and ever
354 since the Tribune, of New York, and the Philadelphia Ledger, have been printed on straw paper, showing the commercial value of the patent.

"Notwithstanding this result, the owner of Spofford patent made no experiments on the boiling of straw in the boiler for the purpose of making white straw paper.

"Then the thought occurred to A. Mellier to try high pressure; he made experiments (to the cost of $5,000 and two years' labor) and found—

"1st. What pressure is most advantageous.

"2d. What is the best degree for the liquors.

"3d. What quantity of it is wanted.

"4th. What quantity of bleaching powder is necessary to complete the operation.

"5th. What preparatory and subsequent treatment by washing, &c., are most proper.

"The result, compared with Spofford's, is, that neither made white paper. When Spofford did not, and compared with Coupier & Mellier's patent, it is that white paper is made by the new process at a great reduction of cost, namely, two cents a pound less.

"The result obtained is new and useful. Is not Mellier entitled to a patent for the means of obtaining it?

"I understand that Mellier has to pay a fee for using a rotary boiler, it being patented; but it seems to me that A. Mellier ought

to be patented, so as to prevent Spofford from using his own boiler in the manner discovered by A. Mellier.

"Subsequently to the first experiments Mellier discovered there was an advantage in having the liquors separated from the steam used for boiling.

"This is a secondary claim to which you seem inclined to believe him entitled; but this is only accessory to the new process, and this alone would not enable him to protect his discovery. I will be much obliged to you, sir, if you give me a hint as to the manner of claiming what belongs to A. Mellier.

355 "I understand that Spofford has discovered a boiler to boil any substance in any liquid, and is to be paid by those who use it. And that A. Mellier has discovered, that by 1st, washing straw; 2d, boiling it in fine caustic soda from two to three degrees under pressure of seventy to eighty pounds; 3d, by washing again with acid water; 4th, by bleaching in chloride of lime, at from one to one and a half degrees, he obtains this result not obtained before, of making white paper cheaper than it was ever made.

"Would this, in substance, meet your approval as a claim for A. Mellier's process? I see in your directions that you are less stringent with inventors than with patent agents. I am not a patent agent, and claim your assistance.

"I remain, sir, respectfully yours,

"V. BEAUMONT.

"P. S. Should you grant my request, please direct to me as to what I can do as attorney, and as to what has to be done by A. Mellier himself."

96 *Walker Street, N. Y.*

Endorsed: M. A. Chas. Mellier to office. Filed 4th October, 1856. 3,751—6.

November 10, 1856.

To the hon. COMMISSIONER OF PATENTS:

SIR: I have written to you about A. Mellier's application towards the first of this month, and have as yet received no answer. I hope the letter has not miscarried.

I send back A. Mellier's specification which may be necessary for your answering me.

Respectfully yours,

V. BEAUMONT.

Endorsed: M. A. Chas. Mellier to office. Filed 13th November, 1856. 3,751—8.

U. S. PATENT OFFICE, *Nov.*, 1856.

SIR: In reply to your letter of 31 Oct. last, in relation to your process for treating straw for paper-pulp, I have to state
356 that the office made a careful examination of your case, and

gave you the best directions it could to enable you to get all that you are entiled to in the premises. If you do not approve of this, then you should employ counsel, or be your own counsellor. The office cannot afford time to give you the detail of the present state of the art of treating paper-pulp stuff in the crude state. You can amend as required, or take such other course as your wisdom may dictate in the premises.

Respectfully,

M. A. C. MELLIER,

Care of V. Beaumont, esq., 96 *Walker Street, New York.*

Endorsed: Office to M. A. C. Mellier, 11th November, 1856. 3,751—7.

NOVEMBER, 1856.

In answer to yours of the 10th inst., you are referred to the official letter of the day next following. Your specification is herewith again returned to you, to enable you to amend the same as suggested.

M. A. CHARLES MELLIER,

Care of V. Beaumont, 96 *Walker Street, New York.*

Endorsed: Office to M. A. C. Mellier, 14th November, 1856. 3,751—9.

EVERETT & POLLAK,

American and Foreign Patent Agency,

No. 476 *Seventh Street, opposite the Post Office,*

Washington, D. C.

Filed 22d December, 1856.

I hereby amend my specification of impt. in the manufacture of paper, by erasing the claim and substituting the following:

"But what I claim as my invention, and desire to secure by
357 letters patent, is: The use of a solution of caustic soda (NaO) in a compartment of a rotary vessel separate from that which contains the steam heat, substantially as described.

"I also claim the within-described process for bleaching straw, consisting in boiling it in a solution of pure caustic soda (NaO) from 2° to 3° Beaumé, at a temperature not less than 310° Fahrenheit, after it has been soaked and cleaned and before submitting it to the action of a solution of chloride of lime from 1 to 1½ degrees, substantially as described."

A. MELLIER,

By his attorney V. BEAUMONT.

200.

PATENT OFFICE, 26*th Dec.* 1856.

SIR: Your specification is retnrned to you herewith for amendment. Treating vegetable fibre of almost every kind known by alkaline solutions has been familiarly known to paper-pulp makers since the experiments of Lady Moira, in the last century.

In a patent granted you in August, 1853, you laid claim to have

made the discovery that treating straw and other materials as set forth, (at 8° to 10° Baumé,) was a great novelty. The office allowed you a very liberal claim. You now come again and ignore the principle you then assumed, and claim just the reverse, that is, a very weak alkaline solution. More than twenty applications for treating fibre with alkali of various strengths and in varied ways have been made since your last patent, and five-sixths of all these have been permanently refused, and most of them withdrawn.

This office has taken some extra trouble to examine your case and to show you what you might, as it believes, legitimately claim. Instead of accepting it, you have made an additional claim, that would be worthless if granted you, because it would be complicated with devices already before the office.

No specific strength of alkaline solution such as you have named can be allowed you, nor any degree of heat or pressure of boiler.

Had you taken the claim given you in the words of the official letter of Oct. 22, 1856, it would have been a broader and
358 equally safe claim with that you have proposed, as your own good sense would show you by carefully comparing the two.

The second claim must be cancelled before the first can be admitted.

Respectfully,

M. A. C. MELLIER,
V. BEAUMONT,
96 *Wall street, New York.*

Endorsed: Office to Mellier, 24th Dec., 1856.

WASHINGTON, *April* 15, 1857.

To the COMMISSIONER OF PATENTS:

SIR: In reply to your letter of Dec. 24, 1856, I have to say that after five years of laborious study, and after numerous and expensive experiments I have succeeded to invent a new process, subject-matter to my second claim of my specification of improvements in the manufacture of paper from straw, and I am happy to say that my efforts were crowned with success. Several paper mills in France, England, Ireland, and America are about to be or have been established, operating after the process described and claimed, whereby paper is manufactured at a greatly reduced price. From this declaration usefulness cannot be contested, and, as to novelty, there can be no shadow of a doubt. There must be some cause for manufacturing paper for less than two-thirds the cost than by the old process. Now, what is the cause? The general use of caustic alkali is well known, but what is unknown is to use it at a certain degree of concentration (from 2 to 3° Baumé) in connection with a temperature not less than 310° Fahreinheit. I am so aware of the importance of my improvement that, with all due regard to the opinion of the office, I am bound to decline to amend the claims suggested.

Very respectfully yours,

A. C. MELLIER,
By his attorney V. BEAUMONT.

Endorsed: Filed April 16th, 1857. Mellier to office.

359 U. S. PATENT OFFICE, 18*th April*, 1857.

M. A. C. MELLIER, *care of V. Beaumont:*

SIR: The claims of your paper pulp process have been examined.

The first claim is admitted as it stands. The second claim is refused on the patent of Lemuel Wright of 27th March, 1847.

Wright used the caustic alkaline liquid at 2° to 4° Beaumé after the material had been cleaned by the lime-water process, under the heat of high-pressure steam, and previous to being treated with the chloride of lime. If you chose to cancel claim 2 the specification returned herewith will give you the opportunity.

Respectfully,

Endorsed: Patent Office to Mr. A. C. Mellier, 18th April, 1857. 3751—13.

WASHINGTON, *April* 18, 1857.

To the COMMISSIONER OF PATENTS:

SIR: After corresponding with the office for several months without much progress, I have come to this city for the sole purpose of hurrying Mellier's application for a patent, and it has taken me a full week to obtain from the office a letter which is not a decision. These delays have already been very injurious to Mellier's interest, and as I, his attorney, cannot remain any longer in this city, and as I, moreover, do not intend to change a word in the claims, I request you to recognize Messrs. Everett & Pollak as my duly authorized counsels in this matter, and also to direct all correspondence to them.

I hereby ratify any of their actions in this case.

Very respectfully yours,

V. BEAUMONT,
Attorney for A. Mellier.

Endorsed on face: Filed April 21, 1857.

360 WASHINGTON, *April* 20, 1857.

To the COMMISSIONER OF PATENTS:

SIR: Your letter of April 18th is received. Your reference and argument against the second claim of Mr. Mellier's application is deemed insufficient to induce the applicant or his attorney to withdraw or cancel the said claim. We will therefore consider this action as the first rejection, and now we respectfully request your consideration of the case without requiring the renewal of the oath, (Mr. Mellier being in Europe.) We are, however, authorized to give you the declaration that the applicant relinquishes the right of withdrawing two-thirds of the fee paid in the office after your complying with our request.

Very respectfully,

EVERETT & POLLAK,
Counsels for M. Mellier.

Endorsed on face: Filed April 21, 1857.

WASHINGTON, *April* 21, 1857.

To the COMMISSIONER OF PATENTS:

SIR: Yours of the 21st inst. is at hand. You tell me to furnish the reasons why, and my doing it will make further action about relinquishing the withdrawal fee, &c., unnecessary for the present.

I have left with Mr. Pollak yours of the 18th inst., and my notes on Wright's patent. I cannot accordingly be positive as to dates and numbers.

I do not consider the reference of the office of the 18th as sufficient for refusing to grant us a patent for the reasons included in the following narrative:

Shortly after Mr. Wright obtained a patent for manufacturing paper from straw he went to France (Normandy) and sold his French patent to a company. A. Mellier was appointed superintendent; a large mill was built, but the process failed entirely; modifications were tried at great expease, and finally the directors decided to have nothing more to do with the straw. Mr. Mellier, who had become interested in this subject, left his situation and proceeded with experiments at his own expense till he succeeded in discovering his first process, patented as Coupier & Mellier. The Philadelphia Ledger and N. Y. Daily Times are printed on paper made in this manner.

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The process now submitted to you is an improvement on the last. To part of the soda the effect of a very high temperatnre is substituted, which is a first saving; the result is a stuff that can be bleached with less chloride, which is a second saving. Less time and less labor are necessary, which form another gain.

The same reason why Coupier & Mellier's process is different from Wright's are good to show that the new process is different also, and that both in relation to Wright's are new and useful.

White straw paper cannot be made by Wright,s process. When straw has been acted upon with lime no amount of soda or soda and heat and of chloride of lime that will not eat up the fibres is sufficient to bleach it. Lime and soda are both alkali and both loosen the fibres of straw, but (a fact discovered by A. Mellier) when soda makes also the coloring matter loose, lime makes it fast.

In Mellier's process the straw is soaked in water, boiled in caustic soda, washed and bleached, altogether twenty-four hours.

In Wright's process twenty operations are necessary, which, added together, make about sixty hours. Mellier's makes half stuff for the beating engine. Wright's makes pulp ready for the machine. Mellier's makes now in England in two mills what is stated in his specification.

Wright never did and never will apply his process, because it is contrary to the law of chemistry.

The history of this manufacture is—

1. Making yellow paper from straw by boiling in lime-water in open vessels, no possibility of bleaching; this process is the same to this day.

2. Wright's invention substituting soda to part of the lime in

closed vessels makes bleaching possible, but at a great expeuse of fibres eaten up and of chemicals left alone as not paying.

3. Coupier and Mellier's substituting caustic soda at 10° but in small quantity of lime, carbonate of soda, in an open vessel, is a paying process, practical here, in France, England, and Ireland.

4. Mellier's new process, substituting high temperature and agitation in a rotary boiler to part of the caustic soda, has for
362 effect to make the coloring matter more loose and bleaching more easy. Substituted to C. & M. process in two mills in England.

Respectfully yours,

V. BEAUMONT,
96 *Walker street, N. Y.*

Endorsed: M. A. C. Mellier, to office. Fled April 28, 1857.

U. S. PATENT OFFICE, 21 *April*, 1857.

M. A. C. MELLIER,
Care of Victor Beaumont, 96 Walker street, New York:

SIR: Your letter of the 18th instant, respectiug your application for a patent for paper-pulp process, has been duly received, but the practice of this office will not permit two agents to bind the applicant to relinquish the withdrawal fee as a substitute for nenewing the oath, in cases like the present.

If, therefore, you choose to bind your client to relinquish the withdrawal fee, you can do it, but your substitutes cannot be permitted to do so.

You say the references of the office of the 18th "is deemed insufficient." Therefore you ask a reconsideration. You should furnish the reason why the references are deemed insufficient. When you have done so, there will perhaps be a ground for reconsidering the action, and possibly for granting the patent.

Respectfully,

——— ———.

Endorsed· M. A. C. Mellier, office to. 21 April, 1857. 3,751—15.

WASHINGTON, *April* 27, 1857.

To the COMMISSIONER OF PATENTS:

SIR: We have received your letter of the 21st.; also Mr.
363 Beaumont's reply, which we have the honor to present to you.

You will please notice Mr. Beaumont's letter of 20th, requesting you to correspond with us.

Very respectfully, yours,

EVERETT & POLLAK.

Endorsed: Filed April 28, 1857.

P. O., 28 *April*, 1857.

M. A. C. MELLIER, *care of Everett & Pollak:*

SIR: In reply to yours of the 24th, duly received, which comes to the office deficient in the renewed oath on what is taken as its equivalent, your relinquishing the two-thirds fee on account of the withdrawal, I have to state that your case can make no progress towards completion.

In your previous letters, filed 21 April, 1857, you ask of the office a reconsideration, without giving any ground for such act. The office called on you for your reasons. You have now given your reasons, but, before the office acts, you must renew the oath or relinquish the fee.

Yours,

———— ————.

Endorsed: Office to Mellier. 28 April, 1857. 3,751—7.

NEW YORK, *May* 2*d*, 1857.

To the COMMISSIONER OF PATENTS:

SIR: I hereby relinquish the right to withdraw two-thirds of the amount paid by me upon A. C. Mellier's application for patent for improvement in the manufacture of paper from straw, and respectfully request that the case may be reconsidered as early as possible.

Your obedient servant,

V. BEAUMONT,
Attorney for A. C. Mellier.

364 WASHINGTON, *May* 4, 1857.

To the COMMISSIONER OF PATENTS:

SIR: You will please notice enclosed declaration for relinquishment of Mr. Mellier's withdrawal fee.

We have to request your early attention to this case, considering that the invention has been patented abroad long ago.

Very respectfully, yours,

EVERETT & POLLAK,
Attorneys for A. C. Mellier.

Endorsed: Mellier to office. Filed 4 May, '57. L. D. G. Relinquishes withdrawal fee. 3,751—18.

U. S. PATENT OFFICE, 5 *March*, '57.

M. A. C. MELLIER, *care of Everett & Pollak, present:*

SIR: This office has again examined its action of 18 April on the subject of your second claim, for treating rags in pulping processes for ash-paper manufacture, and in connection with your letter, filed 21 April, '57, (3,751—14,) which contains your grounds of . In the reconsideration, the whole question has been reviewed, without finding any good reasons for changing the decision of the 18th April.

Respectfully,

———— ————.

Endorsed: Office to Mellier. 5 May, 1857. II. Rejected 2d claim. 3,751—19.

WASHINGTON, *May* 11, 1857.

To the Honorable CHAS. MASON, *Commissioner of Patents:*

SIR: We have to appeal from the decision of the examiner in the matter of M. C. Mellier's application for patent for improvement in the manufacture of paper pulp from straw.

In the hope thas you will give your personal attention to
365 this case, we would request to be permitted to present a verbal argument.

Very respectfully, yours,

EVERETT & POLLAK,
Attorneys for M. C. Mellier.

Endorsed: Rec'd and referred to comm'r, May 11, 1857. Everett & Pollak, agents.

U. S. PATENT OFFICE, *May* 13, 1857.

SIR: In the application of M. A. C. Mellier for a patent for alleged improvements in the manufacture of paper, twice rejected and referred to me for revision, I have the honor to report that the invention consisted in subjecting straw and other such fibrous materials to a pressure of at least seventy pounds to the square inch, when boiling in a solution of caustic alkali. The process was for the manufacture of white paper from straw, which was not well bleached by any of the known processes. Boiling under high pressure in a weak solution of caustic alkali, using a great degree of heat, (about 310° Fahrenheit,)it is alleged, involves important economies in time, as well as in the expense of manufacturing white paper from straw. After thus boiling a sufficient length of time, the straw is washed with, first, hot and then cold water, until the water runs clear; the straw is then steeped for an hour in hot water, acidulated with sulphuric acid, after which it is again washed and bleached as usual, but requiring a smaller quantity of chloride of lime than is required in bleaching after the known processes of preparation.

The first clause of the claim is admitted by the office letter of the 18th April, 1857. The second clause is limited to the process involved in the recital of invention and the description as above stated, and is in the following words:

"I also claim the within described process for bleaching straw, consisting in boiling it in a solution of pure caustic soda, (Na. O,) from 2 to 3° Baumé, at a temperature not less than 310° Fahrenheit.

After it has been washed and cleaned, and before submit-
366 ting to the action of a solution of chloride of lime from 1 to $2\frac{1}{2}$°, substantially as described." This clause of the claim was refused on Wright's patent of the 27th of March, 1847.

Wright's invention consists "in the novel arrangement and construction of the several parts of the machinery or apparatus employed, and in the application of the same to the process of reducing and bleaching straw, &c., to be used in making paper, including washing the straw, grinding it into pulp, washing the pulp, boiling the pulp,

and washing and bleaching the pulp after having been boiled. In one stage of his process he boiled his pulp or straw "for about six hours in lime water, as afore described, mixed with an alkaline solution of specific gravity of about 2 to 4° Beaume hydrometer per rata, according to the nature of the material to be bleached;" and though this boiling is in a clean vessel, no reference is made to any particular degree of pressure; the pulp is then agitated in the ordinary solution of acid water used for bleaching, washed and again boiled in a solution of alkali about 2 to 4° for about four hours; the pulp is again washed, agitated in a solution of chloride of lime for about two hours, brought to the boiling point, "until the bleaching liquor is entirely spent," again washed, and finally scoured, when it is ready for the manufacture of white paper.

It does not require a minute comparison of these two modes of manufacturing straw paper to demonstrate that they possess, as processes, different and distinct features that must produce differences of result.

The applicant uses a weak solution of caustic soda in very small quantity in boiling his straw, and holds it comparatively a very short time under a high degree of heat and a heavy pressure; and altogether free from lime, which is alleged to tend to fix the color, and makes the production of white paper from straw almost impossible, with a proper regard to the strength of the paper stock.

Wright, on the contrary, mixes with his lime water in which the straw is first boiled, an alkaline solution of specified strength, 2 to 4° Beaume, but in quantity adapted to the particular material, and to the purpose for which it is used, heats it a long time, and without regard to the particular degree of pressure or temperature.

I am of opinion, therefore, that the reference was not ap-
367 posite, and that the second clause of the claim may be allowed without a fear of effecting the patent of Wright.

Most respectfully,
Your obedient servant,
HENRY BALDWIN.

Hon. CHAS. MASON, *Com. of Pat's.*

Approved: C. MASON, *Comm'r.*

Endorsed: M. A. Chas. Mellier. Report, filed May 15, '57.

M. A. Charles Mellier, manufacture of paper. Patent allowed, for reasons on file May 15th, 1857.

C. MASON,
Commissioner.

N. B. I.

Endorsed: Rec'd and filed May 15, 1857.

Caveat. 3,751. *No.* 17,387.

M. A. Charles Mellier, of Paris, County of , State of France.

MANUFACTURE OF PAPER.

Received	October	3, 1856.
Petition	"	"
Affidavit	"	"
Specification	"	"
2 Drawings	"	"
Specimens	"	"
Model	"	"
1 Cert. dep., $300	"	"
Cash		
Examined L. D. Gale	May	15, 1857.
368 2, Issue Shugert	"	"
3, Patented	"	26, "
" in France	Aug	7, 1854.
" " England	Oct	26, 1855.

Recorded vol. 77, page 607.

VICTOR BEAUMONT,
No. 96 *Wall st., New York.*

Endorsed on side: Patented in France, Aug. 7, 1854; patented in England, May 2, 1855.

1, Report to examiner	October	7, 1856.
2, Specification returned	"	9, "
3, 4, Letter	"	9, "
5, Returned specifications	"	23, "
6, 7, " "	Nov.	11, "
8, 9, " "	"	14, "
10, 11, Returned	Dec.	24, "
12, 13, Returned I., 2d claim, and returned specification for amendment	April	18, 1857.
14, 15, Letter to agent	"	31, "
16, 17, Letter about oath	"	28, "
18, 19, Rejected II., 2d claim	May	5, "
20, Reported and passed by Baldwin	"	15, "

Endorsed: Improvement in making paper pulp.

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370 *Exhibit (C. M.)—Decision of the Commissioner of Patents.—Application of Watt & Burgess.—Improvement in making Paper.*

The applicant proposes to make paper from woody fibre by treating it in a certain manner. Chemists have before shown that, by treating woody fibre in a manner not widely dissimilar to that pointed out by the applicant, a substance which is termed cellulose is obtained. It was also known that cellulose constitutes, in an almost pure state, the substance of which paper has heretofore been made.

Under these circumstances it has been thought that the making of paper in the manner pointed out by the applicant was not patentable. But it is one thing to ascertain a scientific fact, and it is another, and a very different thing, to subjugate that fact to the common every day purposes of life. The latter is patentable, the former not. Can it be possible that a pine plank can be formed into a ream of paper without including a patentable discovery in the process by which that end is attained?

Now, the chemist, who merely saparates the cellulose from the other ingredients of the wood, cannot stop there and obtain a patent for his discovery.

In order to claim such a patent he must show some practical benefit that will result from it. The benefits of the patent law are entirely intended for the practical man.

371 The man of science makes the great discoveries which the practical man turns to account. The labor of the former may be far the most meritorious; the latter is the only one for whom a pecuniary recompense is provided.

In the case of making paper from wood, if the present applicant cannot obtain the patent no one can.

This of itself would seem sufficient reason for granting the patent.

But by changing our point of view, we shall see the reason of this more clearly. Science had ascertained that cellulose could be obtained from wood, in substance, the same as the fibre of flax or cotton. If, now, some one should contrive means of transforming this cellulose into a substance that could be spun and woven into strong and durable cloth, does any one doubt of the patentability of the discovery? The making of paper would seem almost equally so. Again, the discoveries of the chemist are irrespective of expense. Whether the means used can ever be employed practically in constructing any material from cellulose for common use is wholly unknown, so far as anything has been ascertained from him.

The pointing out a practicable mode of producing cellulose from wood in a manner requiring so little labor and expense as to cause its adoption in the useful arts, involves a patentable discovery.

A patent will therefore be granted.

C. MASON.

372 United States Circuit Court, eastern district of Penn.

AMERICAN WOOD PAPER CO.
versus
JACOB D. HEFT *et al.*

It is hereby agreed in the above case that the following papers, patents, and publications may be filed in this case and used at the final hearing of this cause as though they had been duly proved before an examiner, viz:

1st. Brevet d'invention. M. A. Seguin. May 22, 1801.
2d. " " Bronzac, Chaptel & Darcet. December 30, 1824.
3d Louis Lamberts. U. S. Patent Franklin Journal, 1826.

4th. Practical Treatise on Dyeing. 1841.
5th. Lafforest Berryer. November 24, 1825.
6th. Extract from Silliman's Journal. 1829.
7th. Handbook of Paper Manufacture. 1835.
8th. Edenburg Encyclopedia, Vol. III. 1832.
9th. Encyclopedia Brittannica, Vol. V. 1810.
10th. Brevet d'Invention. M. Wise. May 12, 1838.
11th. " " Montgolfier Freres. Feb. 7, 1838.
12th. " " Legoux. March 12th, 1839.
13th. American Patent. Jno. Campbell. 1840.
14th. Brevet d'Invention. Chabert. May 11, 1839.
15th. " " Mege. June 27, 1845.
16th. " " Dubrouchet. September 10, 1848.
17th. " " Roque. Nov. 7, 1845.
18th. " " Clothan Breuil. Feb. 12, 1846.
19th. " " M. Gros. March 20, 1846.
373 20th. English Patent. L. W. Wright. June 15, 1843.
21st. American Patent. " March 27, 1847.
22d. Extract from Report of World's Fair. London, 1851.
23d. Central Blatte, No. 29. Nov. 15, 1852.
24th. Deutsh Papier Fabri. May 15, 1852.
25th. " " No. 27. September, 1852.
26th. Industrie Austelling zu London. 1851.
27th. Central Blatte. May 15, 1852.
28th. " " December, 1852.
29th. Transaction of Berlin Society. 1846.
30th. Provisional Specification English Patent. Jno. Cowly. April 16, 1855.
31st. Provisional Specification English Patent. L. Juillon. June 21st, 1855.
32d. Provisional Specification English Patent. J. Jeyes. Oct. 3, 1854.
33d. American Patent. Coupier & Mellier. August 2, 1853.
34th. English Patent. Watt & Burgess. August 19, 1853.
35th. " " F. B. Houghton. August 4, 1857.
36th. American Patent. A. S. Lyman. August 3, 1858.
37th. Regnault's Chemistry, p. 446. 1852.
38th. Dr. Muller's Manufacture of Paper. 1855.
39th. Paper Manufacture, Paris, p. 34, vol. V. 1858.
40th. " " Pielte. 1861.
41st. American Patent. Whinfield & Jillson. October 9, 1855.
42d. " " Ladet of Paris. August 7, 1854.
43d. Berthollet on Dyeing.
44th. English Patent. Mellier. May 2, 1855.
45th. Provisional Specification. Mellier. October 10, 1854.
46th. French Patent of Coupier & Mellier. May 17, 1851.

H. E. WALLACE,
Attorney for Plaintiff.
GEORGE HARDING,
Solicitor for Defendants.

September 15, 1866.

374 *Exhibit I.*

Brevet d'Invention Old Series to M. Armand Seguin, vol. 3, page 266. 215, May 22, 1801. Patent for 10 years.

For a method of making paper from straw and other vegetables, and for the preparation of rags for paper-making.

To M. ARMAND SEQUIN,

Member of the National Institute of France.

Process for making straw paper.

Take some straw, says the author, break it up, and soak it; mix it either with lime water or with soda or caustic potash; let it be until it is sufficiently softened (literally weakened) to make a pliable pulp; wash and grind that pulp either with a pestle or with a cylinder, and reduce it to sheets in the ordinary manner. By this process colored paper will be obtained.

If a more beautiful paper is required, the knots and bark (or rind) are removed, which can be used for making in the same manner the most ordinary kind of paper.

In order to obtain paper of a still better quality, it is necessary to pass the pulp through chlorine (literally oxygenated muriatic acid) until it is sufficiently well bleached, and then wash it with a little sulphuric acid and water.

By following this process paper can be made from flax, hemp, dead leaves, aloes, reed, grass, sugar cane, bark of trees, and in fine from the majority of fibrous vegetables, but especially from the palmiferous, the grassy, the liliaceous, the staminate and the malvaceous.

Process for rendering rags without putrification suitable for readily making paper; soak the rags either in lime water or in soda or caustic potash, or in sulphuric acid at .30, or in any of the other mineral acids of the proper degree of strength; leave them until they are sufficiently weakened; wash them; reduce them to pulp, and make of them paper. If you desire more beautiful paper, pass the pulp through chlorine (oxygenated muriatic acid) until it is properly bleached; one can, at will, mix all these pulps in different proportions, so as to obtain a paper more or less beautiful.

Exhibit II.

Brevet d'Invention, old series, vol. 41, pp. 359, 363. 4,388. 30 December, 1824. Patent for 15 years.

To Messieurs BRONZAC, CHAPTAL, and D'ARCET, *of Paris.*

I. For the process of making paper with the straw of various grains.

It is well known that there have been made a great number of attempts to convert the straw of cereals into a paper pulp: These attempts, whose origin goes back to a very ancient epoch, have meanwhile, up to this time, effected no result of real value to our branch of industry. And it is a well-known fact that yet, to-day, in spite

of the high price of rags, the paper made from straw is of a very inferior quality and of very bad repute in the trade.

The difficulty, which had not been yet overcome, was due to the presence of knots and spikes of the straw that was used; these knots and spikes are broken up under the mallet or by the action of cylinders, with much less facility than the body of the straw; from whence it results that it is necessary to grind the straw too much, in order to sufficiently triturate the spikes and knots, or to leave the knots and spikes in too large morcels in the pulp that is brought to the proper degree of trituration. Furthermore the knots and the spikes are not near so easily bleached as the rest of the straw, and so the paper pulp made of straw, up to this time, wanted strength and the felting property, if it had been well bleached, or on the contrary preserved a great "debris" of knots and spikes, having still their yellow color, and rendering almost unsalable, the paper made from that pulp.

We have found a very simple means to obvivate this serious difficulty, which we have just remarked upon, and which has hindered the progress of this branch of industry. What follows shows the principles upon which our process is established.

Instead of breaking up the straw by a mechanical process, we convert it into pulp by the action of chemical agents, which triturate and bleach the body of the straw, without sensibly attacking the knots and spikes, which preserve almost entirely, their volume, their solidity, and even the yellow color that characterizes them.

The pulp brought to this condition is easily freed from the knots, the spikes, and all other parts that it contains not properly triturated by a sifting; sometimes performed with a bolting mill, and sometimes by making use of a simple sieve.

The patent for the invention and the improvement which we demand rests then upon the idea of converting straw into pulp by such a process that one can preserve whole the knots and the spikes, and above all, upon the idea of submitting the mixture of paste, knots, and spikes to a bolting or sifting, of which the effect is to separate entirely the knots, spikes, and all other substances not properly triturated, from the pulp proper, that is, reduced to the proper tenuity.

This being stated, see below the details of the operations which constitute the process which we follow in making paper from straw. The samples of paper which we add to our application will give an idea of the degree of perfection to which we have arrived, and of the importance of the operation of which we have just spoken.

Description of the process of manufacture which we now follow: (The operations upon which rests our patent, forming alone the essential part.)

Of the retting of the straw.

The common crude straw of commerce is taken and placed under pressure in large reservoirs of wood or of lead, or of any other substance not subject to the action of alkalies; upon this straw is turned

some lye of caustic soda.* This lye should be boiling, and
375 mark about 4 degrees of the hydrometer, (1,028 specific gravity;) here the straw is left to macerate until the retting is complete, when the retted straw is subjected to the action of a very powerful hydraulic pressure.

Concerning the fermentation of the straw after the retting.

The straw already retted and compressed is wet in an infusion of flour of malted rye, to which is added some yeast. The temperature of the work shop is now raised so as to produce a good fermentation in the mixtures. This fermentation is arrested when the straw is found to be sufficiently softened. It is then washed in plenty of water and submitted anew to the action of the hydraulic press.

Trituration and bleaching of the straw after fermentation.

The straw that has been subjected to fermentation is taken and placed in a bath charged with chloride of lime pretty strong, (marking up to 16 degrees of the chlorometer of M. Gay-Lussac.) The mixture is well stirred, so as to complete the disorganization, but without attacking the knots and spikes, and thus the action of the chloride upon the pulp is assisted; when it is judged that the pulp is sufficiently divided up and sufficiently bleached, the chloride of lime is separated from it, and it is washed carefully; it is then passed into a bath of water, acidulated with sulphuric acid, and washed anew by decantion.

Sifting the pulp, so as to separate the knots, the spikes, and other foreign substances not triturated.

The raw prepared pulp, as has been said above, is passed into a cylindrical boiler furnished with wire cloth of meshes half a line square.†

This bolter, placed horizonally, is partly plunged in water and receives a proper rotary motion, which forces the pulp moistened in the water, contained in the interior of the bolter, to pass out with it through the meshes of the wire cloth; the water charged with this pulp thus sifted is conducted into the large reservoirs where the pulp readily settles. The water floating on top is readily decanted, and the pulp is placed to drain upon frame furnished with cloth and placed horizontally; the pulp is there completely drained, and in this condition it can be either carried to the cylinder in order to be made fine there, a few moments before it is converted into sheets of paper, or submitted to the action of the hydraulic press, in order to be converted into solid cakes, for ease of transportation, and which, taken to the paper manufactories, may there be formed into sheets almost without any new employment of force.

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*Instead of caustic soda, caustic potash can be used; lime or a solution of sulphide of lime.

†The bolters furnished with wire cloth made of red copper, are those that give us the best results. We have used with success every kind of sieve; we prefer the bolter on account of its form and by reason of the facility with which proper motion can be imparted to it.

These are the details of the process which we follow to make proper pulp from the straw of gramineous plants.

We trust we have described them so clearly that the operation may be well understood.

To make 75 Kilograms of dry paper pulp,

we use	100	"	dry straw.
"	27	"	crude soda, standard of 30°
"	17	"	flour of malted rye.
"	0.334 gr.		of yeast.
"	67	"	of chloride of lime of the standard of 6 degrees of the chronometer of M. Gay-Lussac.

376 The infusion of flour of malted rye is made hot and added to the retted straw, and fermentation started by heating the mixture up to 30° centigrade. That which gives a great importance to the patent under consideration is the mechanical process which is stated, and through which the knots which have been neither retted nor bleached are completely separated after the conversion of the stems of the straw into white pulp.

It is the use of this mechanical process (the sifting the pulp through a bolter constructed with meshes, fixed and turning in a vat full of water) which has afforded for the first time straw papers equal to [to] the most beautiful paper made of rags. This process, applied to the sifting of paper pulp made from reeds, having given us good results, we demand in this relation, an additional certificate to our patent of January 6, 1825, for applying the sifting there described, not only to pulp from straw and other grassy plants, but to pulp of reeds and of other plants that are only with difficulty converted into pulp by the ordinary methods, having all their fibres equally well triturated and bleached.

Exhibit V.

Brevet d'Invention, vol. xliii. (old series,) p. 402, 4,664. Brevet d'Invention de quinze answer, November 24, 1825.

To Messrs. LAFOREST, BERRYER, SON & Co., *of Paris.*

For the manufacture of paper and pasteboard from the waste of texible plants.

Description of the process to be followed in making paper and pasteboard with "chenerotte," or the wood of plants, of which the following is the enumeration: Flax, hemp, nettles, hops, baire, the leaf of the stem and the spike of the grain of corn. From
377 these are excluded all the fibrous parts of those plants which are found in trade under the name of hemp, flax, tow, etc., and which naturally go to make up paper, only wishing to make use of the woody parts of those plants, which we shall always hereafter designate under the name of "chenerotte."

From the wood of all these plants can be made white paper and gray and colored. The manipulations for the kind of paper last named are neither so long nor so complicated.

For white paper.—First operation—maceration.

You must first soak the "chenerotte," at least for twenty-four hours, in water, which must be constantly renewed. It is easy to ascertain when it has soaked enough, by pressing it with the thumb between the fingers. It will then have become flexible, bending easily without breaking.

Second operation—making it fine.

After the water is drained off, the "chenerotte" thus softened is placed under a series of mallets, where it is beaten until it is rendered quite fine, that is to say, reduced to pieces, thin and only two or three lines in length; then the water is again drained off.

Third operation—fermentation.

The "chenerotte" thus made fine and drained is put in a pile in the rolling vat; it is then gently watered with some water in which bran has been boiled, in the proportion of a livre to 20 litres of water. [A livre is 1 lb., 1 oz., 10¼ dr. avoirdupois, and a litre is 1.760 pint.] This is then boiled a quarter of an hour, set aside to rest, and the clear water decanted. The "chenerotte" is sprinkled with this water, raised to a temperature of 30 degrees Reamur. The entire mass should be slightly moistened and from time to time watered with the same water, in order to keep up the proper degree of moisture until the fermentation is well established and somewhat advanced. This may be easily ascertained from the thermometer of Reamur, which, plunged in the mass, should indicate at least 30 degrees. The sprinkling-water, as well as the temperature of the retting-vat, should also be 30 degrees. The fermentation should be pushed to the maximum of the acid fermentation and to the commencement of the putrid. It must be stopped the instant that degree of fermentation is reached. It is then withdrawn from the room or vat and the operations continued.

Fourth operation.

The "chenerotte" is washed in water to free it from foreign particles, and the washing continued until the water comes away perfectly clear, without the taste of acid or of any other impurity.

Fifth operation—heating with lye.

This operation consists of two processes. First, the "chenerotte" is soaked in a tub with lime-water during twenty-four hours, then it is put into the vat described in the "Bulletin de la Societe d'Encouragement," vol. xiv., p. 18, and which is used in England, and there
treated with a solution of caustic soda, of one degree and a
378 half, or two degrees strength at most, by the areometer for
salts, of Baume. In this way the "leesivage" (boiling) in lye goes on by itself without expense and without manual operation.

One can, however, treat it with lye in the ordinary manner, even by employing ashes; but the outlay of using the ordinary method of the washing-women is much greater in combustible material and in hand-labor. The "chenerotte" in this operation takes a yellow color; but this color is not prejudicial in the subsequent operations.

Sixth operation—pulverizing.

The "chenerotte" already treated with lye and well washed is passed into the cylinder in the same manner as rags.

Seventh operation—bleaching.

The pulp made fine and deprived of all the water that can be pressed out under a press such as used in paper mills is put into a large receptacle, of which it only takes up a third part of its capacity, and which has a cover which is closed as nearly air-tight as possible. This vat, made purposely for this, should be round; but the oval tubs of the large paper-mills, in which chlorine gas is used for bleaching, may answer. It would only be necessary to change the cover, which ought to be made like that which we are going to specify for round vats.

It would only be necessary to change the cover, which ought to be made like that which we are going to specify for round vats. The cover is cut at a third of its diameter; the two parts are adjusted by a groove, the one under the other. The large part may be considered as fixed, although it may be removed if occasion requires; it has a kind of box in which passes the shaft of an agitator which we place in the interior. The moveable part serves for introducing the pulp and for taking it out when it is bleached; it is held during the operation by iron hooks, the same as the part which we have designated as fixed. The agitator, which goes very slowly, is moved by a very slight force from the motive wheels or from the engine, if there is one. This cannot be considered as an addition to the expense.

When the material is introduced into this receptacle, the moveable cover is fastened, and through a hole made expressly for it in the fixed part; by the aid of a leaden funnel the cask is filled to within two or three inches of the cover. The quantity is ascertained through an inspection tube outside. When the receptacle is filled with a solution of chloride of lime of two degrees by the chlorometer of Gay Lussac.

The agitator is continually moved during twelve hours, or at most during twenty-four, and then an examination is made of the state of discoloration in which the material is. If the material is not sufficiently discolored, the water is drawn off into a lower vat and retained for commencing a subsequent bleaching. Again, water with chlorine at two degrees is put in. All these various waters are used until they do not show the slightest discoloration by the aid of the chlorometer. By this means, with proper precaution, not a single atom of chloride of lime need be lost, and there is used at most only three lbs. to a hundred weight of material.

The material is well pressed in order to get out all the chlorareted water, and the water is put in the vat which has already received the residual waters, so as to be used for subsequent bleachings. It is then washed in clear water to remove all the chlorine.

Eighth operation"—arivage."

When the operation of bleaching is terminated, the lustre of the pulp is increased by pressing the material into a bath of sulphuric acid of commerce of 66 degrees, held in solution in a quantity of water; two per cent. of sulphuric acid is used. The material is placed in the same vat described in the seventh operation, and left there, kept in motion during three hours at least. The acidulated water is drawn off, the material washed in pure water until it contains no longer any acid which can be known by the color of the litmus paper, which no longer turns red. The material is then arranged for making paper.

Ninth operation—the fabrication of paper.

The material having been prepared, as we have just described, forms a paper, that as it comes from the form and from under the press, is of a beautiful whiteness; but, in drying, it acquires a transparency, which is not pleasant to the eye. In order to render it opaque, and to give it a quality proper for trade, it is necessary to add to it twenty per cent. of talc of briancon, known under the name of Briancon chalk, and which Tlairy calls "talc lanunoice" or impalpable powder, or the same quantity of chalk of chouterean or any other white chalk. This substance is very abundant and not dear; it costs ten francs the hundred weight; and so to 100 pounds of dry paper pulp there is added 20 lbs., which cost 2 francs, and we have 120 lbs. of paper. This mixture is taken to the cylinder which makes it fine, mixes perfectly the substances, and then the pulp is ready for making pulp. The subsequent operations are the same as are followed in making rag paper.

For gray or colored paper it is only necessary to go through the two first operations that we have described; from there it is passed to the first part of the fifth operation; that is to say, it is macerated in lime water; then the sixth operation and then the eighth is performed, and then the pulp is ready for making paper, which is made in the same manner as that which is made from pulp of rags.

This paper thus perfected resembles parchment, and compares favorably with it; it makes excellent paper for hangings, for bookbinding, for hand bills, folding, &c., &c., &c.

Exhibit VI.—Remarks upon bleaching, from the journal of Benjamin Silliman, L. L. D., January, 1829.

Bleachers are generally sensible of the advantages of heat, and various contrivances have been adopted to apply steam heat to the

purpose of bleaching, but I am not aware that any one has attempted to bring his goods into action in steam heat under pressure, nor do I know that there has ever been any mechanical invention brought into practice by which it could be done until my machine was constructed.

379 The French bleachers have taken much pains to use an alkaline solution at the temperature above boiling heat, but without success. They seem to have a correct idea of the probable effect of increments of heat above that degree, but failed in their attempt to reach it through the imperfection of their mechanical inventions, but I can find no evidence of their having conceived an idea of the advantage likely to result from the combined action of heat and motion. Unless the steam is brought to an under pressure, it is evident that no material benefit is gained by steaming instead of boiling; often the reverse, because the heat will never exceed, and the moment it is exposed to the atmospheric air will fall below 212° Fahrenheit or boiling heat; but if the steam is confined, it is easy to raise its heat to 230°, and then the effect upon the linen shows, in the most unequivocal manner, the advantages of augmented heat in bleaching. This effect is not only more strikingly obvious, but is singularly beautiful, when the goods are put in motion, and the degree of bleaching is rendered perfectly uniform. There can be no danger, as some have apprehended, of injuring the linen by excessive steam heat, because the scorching heat of steam is 520° Fahrenheit, a pressure of fifty atmospheres, or seven hundred and fifty-five pounds upon a square inch, a pressure which no ordinary steam apparatus will resist. Steam heat at 350° thermometical, will so far soften soldering as to cause it to yield to the pressure, and the steam pipes will burst. These are facts which I state as the result of my own repeated experiments, in which I cannot be materially mistaken, and therefore I feel justified in saying that it is not possible, with any ordinary working apparatus, to carry steam to so high a temperature as to injure any goods submitted to this action. By giving motion to the linen, under the reciprocal action of steam heat under pressure, and alkaline liquor, the effect is not only more powerful than it can be by bucking, but as already hinted it is more uniform. Every part of the cloth is equally exposed to the operation, and the coloring matter detached from the cloth, floats in the liquor below.

This appears to me to determine the question, which some have raised, whether the coloring matter of linen is actually detached from the cloth, or is bleached up without being detached. When we find that the loss of weight in the various methods of bleaching rags, from twenty to thirty per cent., and when we find the coloring

380 matter suspended in the liquor, and reducible by evaporation to a mucus, it seems to me that there can be no doubt that the coloring matter is removed, at any rate a large proportion of it.

The repeated experiments which I have made upon a considerable scale in bleaching, clearly demonstrate the utility of combining heat and motion. The action is directed immediately and uniformly. The strong affinity which unites the coloring, the glutinous and the

oleaginous matter to the fibres of the linen weakened and rapidly overcome, and opportunity is afforded for their subsequent combination. By this method I have bleached Scotch drills in twelve hours, and Manchester cotton shirtings in four. There will be no occasion to croft cotton goods, but linens receive a clearer and more brilliant white by exposure upon the grass for a few days.

JUNIUS SMITH.

LIVERPOOL, *January 15th*, 1828.

P. S.—I have omitted to notice that the saving in alkali by this method of bleaching, compared with the usual consumption by the English, Scotch, and Irish bleachers, is about twenty-five per cent.

Exhibit VII.

L. Leb. Lenormand's Hand-book of Paper Manufacture, translated from the French into the German, with several additions and annotations, by Dr. William Weinholz. Second volume. Weimar & Ilmenan. 1835. Page 440.

Leuchs, in the sixth volume of his Hand-book of Manufactures, page 156, has made the following remarks :

"In the preparation of paper from straw it would be best to sprinkle the straw with caustic alkaline ley, after having been cut up, and then to steam it. This would soften it and take away most of the colored parts. Then one might wash it and allow it to rot awhile, (with lime,) and work it up into paper, either with an addition of potatoe fibres, mucilage of marsh-mallow, or of lichens, gypsum, or else with a little rag pulp. If it should not be white enough it would become necessary to bleach it with chlorine, but in most cases steaming in the above stated manner is thought to be sufficient."

Exhibit VIII.

Edinburg Encyclopedia, volume III., Philadelphia edition, 1832, Art. Bleaching, chapter v.

"Besides these common processes for bleaching, another has been introduced with great success by Mr. John Turnbull. * * 381 This method of bleaching consists of immersing the cotton or linen goods in a pretty strong solution of caustic alkali, and afterwards exposing them to the action of steam in a close vessel. (Vessel, etc., are described.) * * The cotton or linen goods, having been previously cleansed by steeping and washing, are, after being well drained, steeped in a solution of caustic alkali of the specific gravity of 1.020. After the superfluous alkaline ley has been drained from them, they are arranged on the grating *C* in the receiver. The cover is then placed on the vessel and firmly secured down, and the steam is admitted by turning stop-cock *H*, which communicates with a steam boiler. * *

"When the steam is admitted the action of the alkali is increased by the heat, so as completely to dissolve the coloring matter of the cloth.

By this method of bleaching a considerable saving of alkali is gained, as the whole is completely saturated with the coloring matter of the cloth. * * Five steeps, with exposure to the steam, is sufficient for cotton cloth.

"We here take the opportunity of remarking that at most bleach-fields they are extremely defective in rendering the alkaline leys properly caustic by quick-lime. In order to render the alkali sufficiently caustic, the following process may be followed: To two parts of potash add one part of fresh-slacked lime, finely pulverized. After the lime is added make the mixture boil, taking care that it is agitated by an iron rake, to keep it from subsiding and fixing on the bottom of the boiler. After it boils the agitation will be sufficient to keep the lime in suspension. The ebullition may be continued for two hours and the lime allowed to subside; the clear liquor may be run off for use and the precipitated lime well washed with water until it loses the alkaline taste. The washings may be kept for making fresh alkaline solutions. On examining the quick-lime which has been used it will now be found in the state of a carbonate, having, by its superior affinity for carbonic acid, deprived the potash of this principle, which will consequently be found nearly in the caustic state.

"The power of caustic potash, in dissolving the coloring and resinous matter contained in linen yarn, is at least double the power which it posseses when in the mild or carbonated state.

382 "On account of the comparatively high price of soda it has hitherto been used very little in bleaching. But the manufacture of soda of an excellent quality has already made rapid advances."

Exhibit IX.

[Extracts from books and patents introduced in evidence by defendants.]

Edinburgh Cyclopedia, Am. ed., published by , 1810, vol. 5, Art Bleaching.

"The art of bleaching consists in removing the colored matters intermingled with vegetable and animal substances. Where the coloring matter of plants is extracted from them, the solid fibrous parts * display * whiteness. * White paper and linen are formed of such fibrous vegetable matter, which is bleached by dissolving and detaching the heterogeneous colored particles."

"The solid substance of plants is white ** and ** is separable from the coloring matter by several means.

Cotton and linen bleaching, (which is separately treated of,) may be considered under two points, viz:

"1st. The separation of extraneous substances, ** which is effected by steeping fermentation or weak alkalyne lyes. 2d. The separation of the constituent or inherent coloring matters of these substances, which is effected by different modes." "To remove this substance, (sowins, used by weaver,) and to open the fibres of the cotton, so as to give full effect to the subsequent operation, it is proper to steep the goods * in lukewarm water."

"The use of this process (of boiling in alkaline lyes,) depends upon the properties which alkaline salts have of uniting with the oily and resinous matters, which are either attached to or a constituent part of vegetable fibres, and which contain their coloring particles, forming with them a saponaceous matter, soluble in water, and by that means easily extricated from the cloth. The operation of bucking acts on a similar principle to that of bolling, but in a much more forcible manner, as a greater quantity of ashes is added in proportion to the water made use of, and more heat is received and retained in the large bulk of cloth placed in the bucking tub, which expands the fibres of the cotton, and admits the more powerful action of the alkali, as is easily demonstrated. * *

"To those persons, who wish for a full and minute account of the absorption and power of heat, we recommend a perusal of Count Rumford's interesting essays on the subject of heat."

"This process (of * scouring) consists in immersing * * the yarn or cotton, in a mixture of water and sulphuric acid." "The use of the acid liquor * * is to dissolve * earthy or metalic matters."

Various methods have been invented for the purpose of washing," (after boiling and scouring, and several of these involving beating and washing are then described. "Alkalies acting so important a part, it is necessary to describe the bleacher's mode of using them, which consists in dissolving them in clean water, and thus forming * * an ash lye. To which the more intelligent bleacher, if he does not make use of American potash, or that of a similar quality, adds one-third quick-lime, whereby the ashes are rendered caustic, and their power materially augmented. * * The whole is allowed to settle, and from the pure liquor the work is afterwards supplied; the bleacher in drawing it off, reducing it by the addition of water to the different strength which the goods may require."

"On caustic lime being thrown into mild ash lye, the carbonic acid by which the ashes were rendered mild, abandons the alkali to combine with the lime, leaving the ashes in their caustic state."

"Allowing the cotton or linen, when raw from the loom, to ferment by steeping in warm water, for a considerable time before boiling the cloth in alkaline lye, is of considerable service."

The matter extracted by alkalies from linen yarn, is a peculiar sort of resin." "The coloring matter of cotton is much more soluble in cotton than that of linen."

"The theory of bleaching vegitable matter depends on removing the coloring matters, whether natural or artificial, which cover their solid fibrous parts."

lb., vol. 15, Art Paper.)

"The (linen) rags are boiled in an alkaline solution of potash and lime, for 4 or 5 hours, or, if very coarse, for 8 hours. The purpose of this is to destroy the coarse part of the hemp, commonly called shon or sheave, and which exists in a great degree in coarse linens;" (but adds that,) "bleaching is not now in very common use, on account of the low price of (bleached) rags."

Exhibit X.

Brevet d'Invention, vol. xliii, (old series,) p. 37, 4,566. May 12, 1838.

Patent for fifteen years, forfeited by the order of the King, January, 1841.

To M. WISE, (CHARLES,) of Paris.

For an improved apparatus for treating with lye and bleaching rags, and other materials used in making paper, which apparatus can also be adapted to other uses.

Introduction.

The principle upon which the above-named invention rests, consists in keeping the materials to be treated in constant motion, and in subjecting them to a great heat, which is kept up during the entire operation.

As the necessary movement can be communicated in various ways, so the apparatus that I have invented can undergo various modifications, which may attain more or less advantageously the result which I have proposed.

It will, nevertheless, be sufficient for me to describe the two machines, which have succeeded perfectly in my experiments, and which show the application of the principle here laid down. One of these pieces of apparatus is heated by the steam furnished by a steam generator, and the other is placed upon a furnace, and thus itself produces the steam required.

First. Apparatus—Drawings.

Plate 3d, fig. 1. Vertical section taken lengthwise, of the first apparatus.

Fig. Vertical section of the same taken transversely.

Fig. 3. End view of the same. The same letters refer to like parts in all the figures.

Description.

a a, hollow cylinder, like a boiler; it is made of iron, copper, or any proper metal, and should be of any required size. *b b* hollow axis through its whole length, or only in one part upon which is fixed the cylinders *a a*. This axis turns in chairs fixed in a framing in the ordinary manner. Neither the supports nor the framework have been shown in the figure, as they offer nothing of importance. This axis by its end *b'*, receives its steam coming from a boiler, and as it is pierced with little holes throughout the whole part enclosed in the cylinder, it thus gives passage to the steam, so that it may spread itself inside the cylinder. A stuffing box is arranged, in the common way, for introducing the steam in *b'*.

c c, iron grating dividing the boiler into two equal parts. In place of the grating a partition can be used, made of metal or other material, and pierced with a large number of holes.

The grating *c c* has a partial movement upon the axis *b b'*, as one sees it in fig. 2, where *c c* shows one of its positions, and *c' c'* the other position. These movements equal in extent the opening of the cylinder, and are limited by four stops *d d d d*.

e, gearing mounters upon the end of the axis *b b'*, and put in motion by a crank and the pinion *f*.

The gearing *e* and the crank *f* can be replaced by a pulley driven by a band, receiving motion from a steam engine or any other motive power.

g g g, are man-holes for putting in and taking out the material to be operated upon. These holes are closed by covers that admit of the passage of neither liquid nor steam.

x, pipe for drawing off the liquid used for treating with lye or for washing.

Operation.

The material to be treated is introduced into the cylinder *a*, through the main holes *g g g*, and half placed in each one of the divisions formed by the grate or partition *c c*. A sufficient
383 quantity of lye or alkaline liquor is poured into the cylinder to cover the hollow axis *b b;* then the steam is introduced into the cylinder, and finally the crank put in motion. The cylinder turns upon the axis *b b*, just as upon two trunions, and the materials under treatment are constantly penetrated by the lye, which, by its own weight falls back again to the bottom of the cylinder.

The rags can be previously soaked in a very strong lye, and then introduced into the apparatus; it will then only be necessary to let the steam enter into the cylinder, and the rest of the operation will go on as above cited.

When the treating with lye is finished, the liquor is drawn off through the cock *h*, and pure water is turned into the cylinder; the motion of the crank is kept up for some minutes; the water is drawn off, and the material removed perfectly treated with lye and ready to undergo the operation of bleaching with acids after ordinary methods.

Observations.

It is perfectly evident that the apparatus above described can be modified by the placing two or more grates in the interior of the cylinder *a a*, which will be thus divided into four receptacles, or even a greater number.

The cylinder can remain fixed and only the grate be made to turn, which would thus successively pass the materials through the alkaline bath, or rather, if one should prefer to move the cylinder an oscillatory motion could be given to it.

Still farther, the cylinder could be made to turn upon its transverse axis instead of upon its longitudinal. The grate would then receive the modifiations necessary for this arrangement.

These various arrangements would only be modifications belonging to the apparatus now described, and would be but a development of the same principle.

Second apparatus.—Drawings.

Figure 4. Vertical section taken through the apparatus and its furnace.

Figure 5. Longitudinal section of the same apparatus separate from its furnace.

The same letters show the same parts in two figures.

i i, wall of the furnace.

384 *j j*, grate supporting the fire.

l, ash box.

m m, vents or flues in which the flame circulates.

n n, cylindrical boiler, or of any other appropriate form, having a cover *o o*, sufficiently large to allow the introduction of an interior cylinder, which will be described: the cylinder being introduced, the cover is fastened so that it shall be hermetically sealed.

p p, cylinder supported by two trunions which pass through the boiler *n n*, and through two stuffing boxes not shown in the drawings, which boxes prevent any escape of steam.

The cylinder *p*, is composed of a body upon which are fixed bands or sheets of metal, some of them having points *r r*, of three inches projection, and others having some holes half a line in diameter. These bands are placed alternately upon the body of the cylinder at a distance of two lines from each other.

s s, journals upon which the cylinder turns; upon one of these journals is fitted a gear wheel with a crank like *e f*, represented in figure 1, for the first apparatus.

t t, opening in the cylinder of proper size for introducing the materials to be operated upon.

Functions of the apparatus.

The cylinder *p p* having been put in place, the material to be operated upon is introduced; the cover *t t* is then closed, but not hermetically. The proper quantity of lye is turned into the boiler *n* by the opening *o o*, which is to be closed hermetically.

The fire is kindled in the furnace and the cylinder put in motion.

The alkaline liquor penetrates into the cylinder through the holes pierced in it, and soaks the material enclosed. The materials are constantly picked in pieces by the points *r r*, and made to pass the boiling lye, which rapidly purifies them and prepares them for the operation of bleaching by means of acids.

When this cleansing is finished the lye is drawn off, the fire extinguished, and pure water turned in for rinsing; the cylinder being kept in movement meanwhile. The water is then drawn off and the operation is finished.

The same observations relative to the possible modification that might be made to the first apparatus apply equally well to the second in reference to the form of the machine and the manner of giving to it the necessary motion.

This system of washing and preparing could also be applied to thread and stuffs of cotton, of flax, hemp, and all other materials that

need to undergo such an operation. In this case the first apparatus would be preferred as the points in the second would injure the thread and fabrics.

385 *Exhibit XI.—No.* 9,215.

PARIS, *February* 7, 1838.

MONTGOLFIER FRERES,—

Patent for ten years, dated February 7, 1838, for the manufacture of paper from wood, as well as pasteboard from bituminous wood.

All the fibrous substances are more or less adapted to enter as constituents of paper-pulp, which may be compared to an ordinary tissue, with the only difference as to the mode of cohesion of the threads and fibrous portions.

Thus, among the number of these substances, the following may be classed in the first rank:

1. Linen.
2. Hemp.
3. Cotton.
4. The nettle and other plants analogous to hemp.
5. Straw, hay, clover, wheat, buckwheat, maize.
6. The leaves of various trees.

The processes for working these various substances are published. Numberless experiments have been made at various times, resulting, generally, in the return to the use of hemp and cotton, as affording a product the most advantageous, both as to quality and quantity.

All the other substances which we have just mentioned have also one of the following objections: Either from their rarity and consequent high price, occasioning a loss too considerable to admit its being made into paper, or, lastly, on account of their producing a paper of bad quality and much inferior to that of hemp or cotton.

But, if all these substances are respectively examined, it will be the more obvious that they contain but a small quantity of fibrous matter, compared with their weight and cost, and consequently it is an expensive policy to abandon rags in order to return to a fictitious substitute.

From the consideration on the one side and the examination made on the other, that the strength which a piece of wood of a long fibre gives, compared with that of a hemp rope, we are induced to believe that in the wood, as well as in the hemp-rope, there must exist a junction of the threads or fibres, more or less analogous to that of hemp, but that divided they must offer a resistance proportional to that of the wood and a hemp-rope of the same diameter.

386 Now, from experiment, a billet of pine, poplar, or a wood of long fibres, of one inches in diameter, presents a strength equal, if not superior, to a rope of Italian hemp of the same diameter, and that, from a cause perfectly simple, which is, that in wood all the fibres are laid lengthways and uniformly, while in a rope, on account of its torsion, the strain is unequal, and every portion is not brought into play.

This remark being made, it is necessary, in operating on wood—

1st. To choose that kind which possesses the longest and most homogeneous fibre.

2d. To expose to a preparatory maceration in order to assist in the removal of resinous gluten, which connects the fibres together.

3d. To aid the removal of the gluten by a concentrated alkaline bath for a considerable time under high pressure.

4th. Then submitting the wood deprived of cohesive medium or of its resin to the action of two series of rollers, of which the one divides it along its length and the other across its thickness, to bring it to the first fibres state.

5th. The treating with alkali a second time in this fibrous state to prepare it for bleaching.

6th. The bleaching by chlorine in a gaseous state by a vacuum progress, operated by means of a reservoir of chlorine in the state of gas. This operation may be instantaneous.

Such is the series of operations employed, and which have afforded a homogeneous pulp resembling that of cotton perfectly fitted for the manufacture of paper, and of a superior white color.

The Lombardy poplar is the wood which fulfills the conditions the most satisfactorily, for the reason that it is free from knots. Nevertheless the fir, pine, and in general, all the white woods, may be successfully employed.

We give the plans and sections of the apparatus which we have used in this manufacture, as well as the proportions of each material employed. We refrain from showing here the process relating to bleaching in vacuo, to which we attach a secret patent, claimed for the discovery of this new paper-pulp.

The advantages of this discovery are easily understood. The minimum actual cost of rags is fifty francs per one hundred kilogrammes, but the average loss is twenty-five per centum, which brings it to sixty-three francs the one hundred kilogrammes.

387 The wood, which we use to partially or wholly replace rags, costs, in Paris, two francs the cubic foot, and one franc in the country; in the proportion of thirty-three kilogrammes to the cubic foot, six francs the one hundred kilogrammes in Paris, and three francs in the country.

100 kilogrammes, on an average,	5 francs.
Lost of 30 per cent	1 50
Cost of manufacturing, over and above that of rags	3 50
Cost	10 francs for 100 kilogrammes.

The particular advantage which the wood-paper we employ possesses, is its capapility of being made of any desired thickness, and its susceptibility of receiving every kind of printing, either sunk or in relief, as well as of every kind of colors, which renders it eminently adapted for painting on, and for the decoration of apartments.

When it is only intended to make a paper prepared as we have stated above, in order to give the fibres the cohesive property, which the alkaline bath and the vacuum bleach has removed, it is necessary to incorporate in the pulp some resin, used in the state of soap, otherwise it is necessary to mix some hemp with the wood-pulp, in the proportion used for cotton.

The application of colors on the wood-paper and the most varied designs can be effected by the following manner:

* * * * * * *

At the end of the continuous dying machine are 2 rolls the diameter of which varies according to the designs to be executed, and which have a surface of one meter 50 centimetres long, like those of the paper machine; the lower rolls is of paper, and is designed to receive the impression of the upper; this roll is very simply made on a turned axis on which is strongly rolled and well strained a given thickness of half dry paper, paste down the end of the sheet, dry the whole, and it forms a roll fitted to be used as a matrix; the upper roll is of wood, on its circumference, are fastened by means of screws, the plates of the design in relief, to be used for printing, and which may be obtained by the following mode.

On a surface of wood, end up, either draw a design or counter draw a given design, sunk the drawing 1 millimetre by means of a punch, plane down nearly to the level of the bottom of the engraving, then place the planed wood in boiling water, in about two hours all the sunken parts come into relief on the roller designed for printing. The relief on the wood makes its mark on the lower paper roll, and by means of the distribution of ink or color on the roller which carries the type in relief; there is produced at will, either a printed endless sheet of paper having all the desired disposition of color and design, the whole almost without cost.

This, as well as the bleaching in vacuo is attached to the patent for wood paper, it is expected that designs, although executed by a roller, may be varied in the same manner as those of the printed cotton, of paper printed by block printing; also the ease of obtaining ornaments in relief or on plain surfaces, in one or several colors may be anticipated; wood paper is eminently adapted to the purpose of these various combinations.

Bituminous paper.

A use susceptible of very extensive application is that of that bituminous paper, which can serve at the same time for building, covering partitioning, ceiling, and paving dwellings, permitting of strength, durability, and elegance.

With the faculty of making wood paper of such a thickness as may be desired and the low price of material, excellent card board can be made—having the rigidity of a board, but this rigidity is not sufficient, it is necessary to render the substance of this card-board impermeable to water, smooth and susceptible of receiving every color and design.

For this purpose, add to the wood pulp in the proportion of one half mineral bitumen or coal-tar, previously mixed with finely ground limestone.

The pulp having all its constituent fibres enveloped in bituminous cement, is brought in the state of paper under the drying cylinder, the bitumen then liquified, and all that which is not absorbed by the interior hardens to the surface and from a varnish impermeable to water, and which will completely replace slate, and be of that color and hardness, and with an immense saving in its first laying and maintenance. The bituminous card-board of 4 lines in thickness, will answer well for tile and covering ceilings in one piece, without joint, of 6 lines in thickness, it can be made into sheds and temporary dwellings, without other additions except 4 pieces at the four corners to form the angle.

Nothing is more simple than the laying it in consequence of the affinity of the bitumen for wood, brick, and other bodies, and its perfect adherence, will suffice to warm the surface of the bituminous card-board and to apply it to the part to be covered, the small number of joints which will be found, considering the indefinite size of the sheets can be cemented by a warm iron with a slight addition of bitumen, if the card-board itself does not afford a joint, commonly called sufficiently rich.

The bituminous card-board, the surface of which is glazed and of a uniform color, can receive any kind of design by the incrustation of sand of various shades; for this incustation it is sufficient to place the card-board on a hot plate of such temperature that the surface of the board is softened thin with a cut out pattern, leaving bare the part to be incusted; every kind of design for shops can be made in letters in relief and in color ornaments of every nature and of every color, approach in the minutest design the wonderful mosaics which the Romans have bequeathed us, with this difference, that the Roman mosaics were reserved for the temples and palaces, while our mosaics can in a given time, decorate the smallest house in the smallest village.

Patent for additions and improvements.

OCTOBER 5, 1838.

We present this day an apparatus for unravelling wood and for separating the ligneous fibre in the direction of their length, for adapting them to the manufacture of paper.

We employ the expression "unravel," because it is one consecrated to paper making, and that our apparatus may not be confounded with the ordinary machine used to rasp the wood for the purpose of making tinctures.

The principles on which we found our real application is the use of a roll finished with toothed blades and rapidly revolving against which the wood is brought, a given quantity of which is removed at each revolution, this roll may be composed of circular or straight blades.

The wood is presented under a roller from which it receives a reciprocating, in the direction of its length while the cutting roll is brought to bear upon it at a rate determined by the forward motion.

Description of the apparatus P. C. 2, fig. 1, 2, and 3. A, the rasping roller composed of circular saws having longer teeth, perpendicular to the shaft, also be composed of straight blades parallel to the shafts *b*. Pulley attached to the shaft A, by means of which a very rapid motion is given.

C D arm of the lever, carrying the roll *a*, and lowering it gradually.

B billet of wood submitted to the action of the roll *a*, *f*, *g*, ratchet and pinion to lower the lever C D at a uniform rate.

h i sliding frame, in which the wood to be rasped is placed.

K rack giving the wood a reciprocating motion.

L pinion acting on the rack K.

M small pinion reciprocating on rack N.

N rack with a reciprocating motion caused by *p* attached to an eccentric in the wheel O.

O pinion receiving its motion from *q*.

P giving a reciprocating movement.

q pinion operated by means of *r*.

R small pinion on main shaft.

S pulley commanding the machine.

T pulley which gives an increased speed to pulley B.

U tightening pulley for the belt.

V wooden frame for the machine.

X crank for lifting the rasping roll when it has finished the billet submitted to its action by means of the pinion Q, acting on the rack *f*.

Second patent of additions and improvements.

OCTOBER 16, 1838.

MONGOLFIER FRERES:

In our principal patent we are chiefly engaged in the conversion of wood into paper, by means of a series of processes designed to separate ligneous from the extractive or resinous parts of wood.

We have said that for effecting this separation, we commence by reducing the wood by the action of two machines, of which the first chops it and the second crushes it; that after this operation the reduced wood was placed in a lime-bath until it was saturated, then submitted to a causlic alkaline solution, under a given pressure, that finally, at the end of these operations, the resin was converted into a soap, soluble in hot water, the ligneous fibres of the wood remaining bare.

In this state, they can, if desired, be employed in the manufacture of white paper by submitting them to a bleaching process, the
388 principle of which belongs to us, and which will be described further on; they may then be at once passed to the machine necessary to convert them either into ordinary paper or card-board. This theory of the conversion of wood into paper always remains the same, but our experience has taught us divers modes more expedi-

tious, both in the reduction of the wood and hastening the solution of the resin which binds the ligneous fibres, or lastly, for the re-cementing again of this soluble resin, after having given, by mechanical means, to the ligneous fibres the form of paper for the purpose of protecting them.

In one word our endeavor has been this:

First. To destroy the primitive form of the wood by loosening the resinous connections which bind the fibres.

Second. After having given the form of paper to the fibres, to return to them their original cement and cohesion, by re-fixing the resin which was rendered soluble by a previous operation.

We will now describe the process of manufacture which we have followed:

First. The dry wood has been reduced to chips by the chopping-machine, plan 2, figure 4.

Second. When in the state of chips it has been emersed for five or six days in quick-lime.

Third. It has been brought into a beating-machine, which has reduced it to a fibrous state by crushing the chips softened by their marceration in lime-water.

Fourth. After the beating or opening out it has been placed in a close vessel with a solution of caustic potash, and boiled under pressure for twelve hours.

Fifth. If this pulp is destined for white paper, it is necessary that immediately after alkaline treatment, the pulp should be washed in hot water to remove the dissolved resin, then submitted to a bleaching process, of which we claim the right for application in paper-making.

This mode of bleaching consists in passing a stream of chlorine-gas into a solution of caustic potash under pressure, in which the pulp to be bleached is immersed. By this process a particular effect is produced, which science alone can explain in a satisfactory manner, but which practically has afforded us incontestable results. In bleaching by the ordinary method, by chloride of lime or chlorine-gas alone, it happens that if the ligneous fibres retain but ever so little
389 resin dissolved by the previous alkaline action, that the chlorine brought into the presence of resin ceases to act, and to remain without effect on the substance.

In our process, however, if portions of the resin remain undissolved, the caustic potash attacks the resinous molecule, adhering to the woody fibre and dissolving it. The chlorine then freely acts on the woody part laid bare, until it is arrested by meeting with another resinous molecule. It is then the turn of the caustic potash to act. By the mutual aid of these two great agents, specially aided by heat, we can obtain the most perfect white.

It is not worth while to expatiate more on this mode of bleaching, the superiority of which may easily be proved.

These processes may easily be proved.

These processes are applicable to the manufacture of white paper. When a brown paper or card-board is to be made it is useless to bleach it; then, instead of removing the soluble gluten or resin, it is

again concreted and precipitated in the pulp by means of a metallic salt, or by alumn.

This operation may be performed either in the grinding rolls or in the engine a short time before the pulp is let down on the machine.

In order to render our wood-paper entirely water proof, and perfectly adapted for any kind of we give it a supplementary quantity of resin or vegetable tar, which we incorporate with pulp, in an intimate manner and which renders the paper or card-board perfectly water-proof.

At this point the ordinary processes for the manufacture of wood paper, and bituminous wood, card-board ceases; but as we have said in our first memoir, we have not concluded our efforts; we have thought that for a product well made and of general use, there will be numerous new uses found. The above is the description of the modes of the results of which we have this day given a detailed account, and which causes us to make the present application.

Roofing of houses.

At present our roofs are covered with tiles or slate of quite a limited size, and which in consequence require a great number of points of attachment, at a considerable outlay for frame-work. By our system, one half the wood for the frame-work can be saved, and there will also be a saving in the cost of tin roofing.

Our roofing is of tarred wood card-board of 2 or 3 lines in thickness, water-proof, and covered with a layer of gravel to prevent it from fire; our mode of producing these gravel boards, consists

1st. In making the paper very strong and rich in pitch.

2nd. 3 or 4 of these sheets are laid together and united in one solid board by means of a press.

3d. Both sides of the board are covered with a composition the constituent parts of which are given in the first note.

Place the hot board on a planed surface, covered with well dried river gravel. The board is covered with gravel on the opposite side, and the gravel is encrusted on the surface wherever it touches, the whole being dried, presents a water-proof surface, and combines economy and elegance.

Water pipes, and conduit troughs, and vessels intended to contain water, wine, and especially chlorine or acid waters which have no effect on bitumen.

In order to finish the water pipes, take a turned mandrill on which roll the board to the desired diameter of the pipe. Join the edges so that they just touch without overlapping them at regular distances, about 25 centimetres apart, fasten the pipe with an iron wire so that the edges may touch, draw out the mandrill, and plunge the pipe into the composition described in the first article, move it about in the composition until the inside and outside are coated, then place it still hot on a table covered with gravel, also hot, on which roll it until the surface is well covered.

In the same manner can be made every kind of vessel adapted to

hold water, wine, and chlorine, and acidulated waters. Similarly can be made fire buckets, water reservoirs, sink, drain pipes, gutters, and in fact everything required to hold liquids.

Old barrels covered by our composition, are as impenetrable as new barrels, and can not only be used for wine but also for chlorine and accidulated waters.

Sheathing for ships.

It may be stated as a fact, that no substance can be better employed than our wood pitch paper placed between the copper and the wood, or applied to the wood without the addition of copper.

As to the preparation of such sheathing it consists in giving to the paper a coating such as is at the same time suple and water-proof. This can be effected by the composition described in the second article. This sheathing can be fastened in large zones of an alternable length of 1 metre 50 centimetres width, having the advantage of showing but very few joints. We have every reason to believe that our sheathing will entirely supplant the use of copper, which sea-water rapidly oxydizes and destroys, while it has no action on pitch paper.

Floor cloth or mosaic for apartments.

Although the use of comfortable floor cloth is not general in France, it is to be hoped it will be sold when the pitch paper can supply this deficiency with a remarkable economy.

Our mode of procedure consists in coloring river sand, well washed from impurities, by means of metallic solutions.

This sand, perfectly dried, is laid on perfectly flat plate, and from such a design as will be well suited for the purpose, by means of an open mould; the design, being properly disposed, pass a roll over it to give it an equal thickness, then take the sheets treated with composition No. 1, place them on the sand and press uniformly on the opposite side. The hot sand adheres, and presents in mosaic, the design formed on the smooth table; when the whole is dry it forms a solid body, representing, at a very low cost, a mosaic of the most complete shade and design.

This mosaic paper is adapted for interior and exterior halls, dining rooms, bath rooms, tables, and especially when a surface is required to be sponged and washed.

Signs and notices.

The same process can also be employed with great economy for permanent signs and notices, by making them of incrusted letters of brilliant stones or colors; this employment of the process is worthy of notice, as it unites great durability with great economy, since the air and rain are without action on the pitch paper, and consequently the signs will remain as they were made for a long time; we have employed, with advantage, for forming our letters white quartz, which shows very well on black.

Composition No. 1.

Mineral pitch	50	parts.
Sifted Gypsum	25	"
Peroxyde Manganese	20	"
Elastic vegetable pitch	5	"
	100	parts.

Composition No. 2.

Mineral pitch	50	parts.
Vegetable pitch	15	"
Talc powdered	28	"
German Manganese	5	"
Yellow wax	2	"
	100	parts.

Brevets a' invention, T. 67, p. 15.

Exhibit XII.—C. 399.

To Mr. MOINIER LEGOUX, of Paris:

Patent for invention for five years, dated March 12, 1839.

For the manufacture of paper pulp from every kind of wood previously reduced to chips, bark, roots, leaves, grammaceous plants, reeds, pulp of tuberculous, leguminous roots, wheat, straw, hay, grasses, mosses, water grasses, marine plants, and finally, all vegetables of whatever nature they may be, the whole by means of new mechanical apparatus and chemical process or of new application.

The aforesaid pulp to be used in the manufacture of paper of every kind, common pasteboard and double pasteboard.

The object of this patent is the application of the mechanical and chemical processes which are hereinafter designated for the purpose of converting into pulp suitable for the manufacture of paper, the substances of which mention has been above made.

390 *Description.—First operation—mechanical processes.*

The first operation, which consists in reducing to fibre the substance intended for the manufacture of pulp, is effected by the aid of the machine of which the detail and the plans are seen in plan 26.

It is sufficient to spread the substance upon an endless web which conducts it into the grooved cylinders; these deliver it to the rasp as they receive it and retain it in case the rasp should tend to draw it in; as soon as it comes in contact with the teeth of the rasp it is instantaneously reduced to filaments of greater or less length. This machine is designed as one of the means by which all the substances mentioned at the head of this specification can be reduced to a kind of tow resembling the half stuff obtained from rags. Another means for which the undersigned claims also protection, at least in its application to the manufacture of paper, is to cut the substance into lengths

of 15 to 20 centimetres, then to subject it to the action of a machine almost resembling those used in spinning cotton when it has been pressed into the bales; this machine consists of one, two, or three cast-iron drums, provided with iron teeth, revolving at great velocity and passing between other stationary teeth in cast-iron traverses placed upon the exterior of the drum; the pieces of the materials, while passing between the rows of teeth will be divided into filaments, and will give the desired product. To this machine there may be applied a feeding web and a mechanism which shall open and close at required intervals, the gates by which the substances enters the machine or leaves it as half stuff.

Instead of this machine stampers may be substituted, or the willowing engines usually employed in paper-making.

There might be probably also other mechanical means by which the substance could be reduced to half stuff; but, in this state, it would still not be fit to be converted into paper without the aid of the chemical processes hereinafter designated.

Second operation—chemical processes.

This operation consists in softening (digesting) the cut substances by freeing them of their gluten and of the resin which they contain; for this purpose they are boiled for a longer or shorter time under a pressure of three or four atmospheres in a boiler in which there shall have been introduced a small quantity of boric acid dissolved in the water in which there has been mixed common soap, as caustic as possible.

This operation, to be rendered more effective, may be preceded by a maceration of the substance in a caustic lye composed of two parts, one of bavilla, soda, or potash, the other of boric acid and of unslacked lime reduced to powder.

The substances having been withdrawn from the boiler are then washed, in order to free them from their gluten or resin decomposed by the chemicals and the boiling.

The pulp thus obtained is converted into paper by the usual means.

Explanations of the drawings.

H. 26 *a*. Frame, consisting of four uprights and horizontal cross-pieces.

b. Cast-iron drum, in which are secured through its length, and at distances sufficiently near to each other, several toothed blades similar to our common saws.

c. Driving shaft upon which the drum is fixed.

d. Pinion controlling the cast-iron wheel *e*, which communicates motion to the shaft placed behind the drum.

g. Cast-iron level-wheel placed upon the shaft of the wheel *e*, and controlling the wheel *h* fixed upon the shaft *i*.

j. Endless screw placed upon the shaft *i*, and giving motion to the wheel *k*.

l. Endless web upon which the substances designed to be rasped are placed. The materials, before coming in contact with the rasp *b*, passed under two grooved cylinders *o' o'*, placed one above the other, and receiving their motion from the wheel *k*, upon the axis of which one of them is secured.

m. Wooden roller, upon which the web is rolled and controlled by a pinion placed upon the axis of the grooved pinion *o'*. *m.* Another wooden roller of the same diameter as the preceding, and also designed to guide the endless web *h*, gear wheel placed upon the shaft of the wheel *e*.

q. Brush designed to clean the rasp of filaments which may fill up the teeth of the blades with which it is provided.

r. Lever carrying at its extremity a weight, and exerting in this way a certain pressure upon the upper cylinders.

z. Cast-iron piece, designed as a rest to the rosean bed, in order to facilitate the operation.

391 *Exhibit XIII.—Patent of John Campbell, June* 11, 1840, *reissued.*

THE U. STATES PATENT OFFICE.

To all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the records of this office of the reissued letters patent granted John Campbell, June 11, 1850, No. 171.

In testimony whereof, I, D. P. Holloway, Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed, this fifth day of December, in the year of our Lord one thousand eight hundred and sixty-two, and of the independence of the United States the eighty-seventh.

[SEAL.] D. P. HOLLOWAY.

Reissue No. 171.

The United States of America to all to whom these letters patent shall come:

Whereas George Spafford, of Windham, Conn., (deceased,) did, in his lifetime, allege that he had invented a new and useful improvement in the machine for boiling and washing rags for manufacturing paper, for which letters patent was granted to him, dated Sept. 2, 1840, in which letters patent he assigned his whole right and title and interest to John Campbell, of New York, N. Y., and the said letters having been surrendered by said Campbell, the same have been cancelled and new letters ordered to issue to said Campbell on an amended specification, which he stated has not been known or used before his application, has made oath that he was a citizen of the United States, that he did verily believe that he was the original and first inventor or discoverer of the said improvement, and that the same had not, to the best of his knowledge and belief, been previously known or used; the said Campbell having paid into the treasury of the United States the sum of fifteen dollars, and presented a petition

to the Commissioner of Patents, signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose: These are therefore to grant, according to law, to the said John Campbell, assignee as aforesaid, his heirs, administrators, or assigns, for the term of fourteen years from the said second day of September, one thousand eight hundred and forty, the full and exclusive right and liberty of making, constructing, using, and vending to other to be used; the said improvement, a description whereof is given in the words of the said Spafford, in the schedule hereunto annexed, and is made part of these presents.

In testimony whereof, I have caused these letters to be made patent and the seal of the Patent Office has been hereunto affixed. Given under my hand, at the city of Washington, this eleventh day of June, in the year of our Lord one thousand eight hundred and fifty, and of the independence of the United States of America the seventy-fourth.

[L. S.] T. EWING,
Secretary of the Interior.

Countersigned and sealed with the seal of the Patent Office.
THOS. EWBANK,
Commissioner of Patents.

The schedule referred to in these letters patent and making a part of the same.

To all to whom these presents shall come:

Be it known that the following is a full, clear, and exact description of a new and useful process for preparing rags and other materials for making pulp in the manufacture of paper, and of the machinery for carrying the same into effect, invented by the late George Spafford, of Windham, in the State of Connecticut, and for which letters patent of the United States were granted to him on the second day of September, in the year 1840, the said letters patent being herewith surrendered for the purpose of having the same invention described and presented in a more full, clear, and exact manner than was done in the original specification, and of having a new patent issued upon the specification so amended.

The invention consists in digesting with an alkaline or other liquid in a close turning vessel the rags or other fibrous materials for making paper pulp, the heat being applied to the exterior of the vessel, or by steam introduced within it, as may be deemed most expedient.

In the accompanying drawing, figure 1 is a perspective view of a close cylindrical boiler and its appendages, one of its heads being removed to expose its interior; figure 2 is a view in perspective of the head detached from the boiler, and figure 3 is a section of the boiler at the line x x of figure 1, showing a diaphragm of strong reticulated wire.

The body of the boiler A A, figure 1, should be made of iron boiler-plate or other suitable material strong enough to resist any internal pressure to which the machine may be subjected, and of any convenient dimensions; one ten feet in length and four feet in diameter

will hold as a proper charge about 1,300 pounds of rags, with the appropriate quantity of lye; say about 100 gallons of a solution of potash, soda, or lime in water.

When other materials than rags are to be operated upon, as for example, straw, cotton-waste, &c., the proportions of the charge will vary, but these variations can easily be determined by the operator.

C C C are man-holes in the side of the vessel, of which any suitable number may be made, and through which the charge is introduced and withdrawn.

The heads of the boiler are provided with tubular journals or trunnions H, by which the boiler is hung in any suitable frame provided with appropriate bearings. The heads are libewise provided with any convenient number of stop-cocks G G, for drawing off the liquid from the boiler. The interior of the boiler is divided into several compartments by longitudinal grated partitions B, which abut at one end against the grated diaphragm figure 3, and at the other against the head of the boiler. The main use of these partitions is to facilitate the operation of washing when the apparatus is occasionally used for that purpose, by dividing the charge into several distinct parts, and in this way rendering the access of water to every part of it more easy and certain.

392 The grated diaphragm seen in figure 3, and whose position is represented by the dotted lines, x x, in figure 1, is likewise designed to facilitate the process of washing by acting as a strainer to retain the charge while a stream of water is passing through it.

Although the operation of washing may be performed within the boiler when it is provided with the grated partitions and diaphragm, yet as this is a distinct process it could be effected with greater propriety in a separate vessel, therefore it would in most cases be advisable to omit the partitions and diaphragm in the construction of the boiler, as well to save cost as because the boiler, as a digester, will answer well without these devices.

When this apparatus is to be used, the charge of rags or other material for making the pulp, and the liquid with which it is to be digested may both be introduced through the same man-hole; or the liquid may be introduced through one of the hollow trunions H; the vessel is then closed, steam is introduced through one or both of the trunnions to heat the charge, and at the same time the boiler is put motion by any suitable machinery which will turn it with a proper velocity; that of about revolutions a minute have been found to produce a good result. The application of heat and the turning of the vessel are continued until the materials are properly digested, the time required being easily determined by practice and varying according to the circumstances of the case. After the charge has been properly digested the steam is shut off, the liquor is drawn off from the boiler, either through the stop-cocks or man-holes, and the digested materials are discharged by revolving the boiler with the man-holes open. It is obvious that the boiler may be varied in its form in the manner and position in which it is caused to turn or move, without affecting the principle of the invention, and it is contem-

plated so to vary its arrangements as circumstances may render expedient. The manner in which the heat required in the process is applied may likewise be varied, as for example by surrounding the boiler with a straight-jacket, or by placing it over a furnace.

Previors to the introduction of the above-described process, the materials were digested in a stationary vessel in which the agitation was produced by the boiling alone, which from the unequal density of the mass was unequal in different portions of the same vessel; hence this process was defective even when the best stock was operated upon, and the paper produced from the same charge was not of a uniform quality. When the more refractory materials used in the manufacture of paper were subjected to this operation, such for example, as straw and cotton-waste, the result was still more defective, as the knotty portions of the straw and the greasy portions of the cotton-waste were penetrated with difficulty by the digesting liquid, aided by the slight agitation produced by the boiling alone.

The process herein described produces such an agitation by the turning of the boiler, and so effectually intermingles the steam and the digesting liquid with the charge, that the latter is digested in the most equable manner with great economy of heat and time; and the knotty and greasy portions of the above-mentioned refractory materials are penetrated thoroughly and acted upon
393 by the digesting liquid and the heat. From the thorough agitation of the charge, no portion of it is liable to be over heated or to be uneqally affected by the digesting liquid; and hence the average quality of paper produced will be better and more uniform than was possible when the stock was prepared by the old process.

What is claimed, is the hereinbefore described process of preparing materials for making pulp in the manufacture of paper by digesting them in a turning vessel with an alkaline solution or other liquid, the heat being applied to the outside of the vessel or by steam introduced within it substantially as herein set forth.

JOHN CAMPBELL,
Assignee of the whole right of the late George Spafford.

Witnesses:
AUGUSTIN SMITH.
JOHN W. WILSON.

[*IX. Here follows map, marked page 393.

Exhibit VIII.

Brevet d'Invention, volume LXX, volume LXX, (old series,) pp. 46, 48, 9,729.

Patent for ten years, May 11, 1839, to M. Chabert, (Claude Evariste,) of Rouen, for the manufacture of paper pulp from the colsa, (kolza or colsa, colewort, a kind of cabbage.)—Note of translator.

After the colsa has been harvested and threshed, the stems and branches clinging to them are taken and macerated in a ditch or vat containing a solution of water and the salt of soda or of potash.

This lye should have about ten degrees of strength.

The material is thus left a sufficient time for it to be macerated.

After this operation the material is pounded in mass.

This beating reduces the stems to tow, that can be bleached by the chloride of lime.

After these processes the material is suitable for making very beautiful and very good paper of all sorts.

First patent for additional improvement.

OCTOBER 22, 1839.

To M. PAUL, of Rouen.

After the seeds of the colsa have been removed from the stems of the plant, the latter are thrown into a boiler containing water,
394 in which a little quick lime has been dissolved. The fire is kindled and the material boiled until the stems have become of a proper degree of softness; three or four hours suffice for the operation.

The bath above mentioned takes hold more energetically upon the stem of the colsa, and detaches more completely the fibres from the woody parts; at the same time it is more economical than the method indicated in the original patent.

When the stems are sufficiently softened they are taken from the bath, and while warm, beaten in a pile by means of mallets. They can, in addition to this, be crushed between fluted cylinders, or preferably, by a mechanical beater.

Whatever the operation may be to which preference is given, it is to be continued until all the woody parts have been removed, and the fibrous material is reduced to tow.

The material thus obtained, is worked in the manufactories of paper, in the same manner as rags for the preparing of paper and pasteboard. This can be used alone, or, according to circumstances, be mixed with pulp from rags in proportion to be determined by the nature of the product that is to be obtained.

The stem of the rape ("rabette") can be treated in the same manner, and nearly the same result obtained. This plant being, however, of a shorter stem than the colsa, gives, of course, less profit.

The object of the present patent, as well as that of the original patent is to utilise, for making paper and pasteboard, the fibrous materials taken from the stem of the colsa, and the rape which is a a plant of the same family, and the present description affords it the means of arriving at these results in a prompt and economical manner.

Second patent for additional improvement.

DECEMBER 3D, 1839.

In the original patent, and in the first for additional improvement, we have indicated the method of treating the stalk of the colsa so as to extract from it the fibrous material, which is then converted

into paper pulp by the processes ordinarily employed in treating rags.

The practical application of the process, described in the original patent, has led us to make trial of the husks or envellopes containing the grain of the colsa. These husks, of which up to this time no use has been made, are, after the threshing of the grain, left in the field where the operation has taken place; they are burned there that they may be gotten rid of. I take the husks and boil them in a bath of clear water, or of water in which I have slacked a very small quantity of quick lime; in a very short time the husks are softened; they are then taken out and beaten by one of the processes shown in the original patent, and are in this manner converted into pulp, which is then treated by the processes generally employed for the manufacture of paper with pulp from rags. As the pulp formed from the husks or envellopes of the grain of the "colsa" is very fine and free from "knots," it can be made use of for all those purposes for which the most beautiful pulp from rags is used The ease of its preparation, and the trifling value of the raw material, allow it to be also used in making the ordinary kinds of paper and pasteboard. The pulp made from the husks of the grain of the "colsa," can he used alone, or it can be mixed with the filaments of the stock, and of the branches of the "colsa," and with rag pulp. The mixture will always be proportionate to the products that one wishes to manufacture.

Patent for invention for fifteen years, dated June 27, 1845, *to Mr. Mege, of Paris, for the preparation of paper pulp.*

In the patent and two certificates of addition dated August 21, 1845, and January 27, 1846, the inventor indicates the preparation, which it is necessary that certain vegetable substances should undergo that they may be employed in the manufacture of paper pulp. In a certificate of addition dated June 24, 1846, the inventor indicates all the operations with the improvements introduced therein.

Impressed by the difficulties which I experienced in extensive manufacture, whenever it was necessary to make the paper pulp with alkaline substances ground my mechanical power, and then bleached, I have sought, by means of chemical analysis and phsiological study, to disintegrate the fibres of an organic tissue, by means of a chemical operation.

This result has the advantage of freeing ligneous fibres of the fatty and resinous substances which they contain, consequently of permitting a perfect bleaching, and that which is more important, of reaching the finest and most obscure fibres of the tissue and of furnishing an homogeneous pulp, which is not effected by mechanical action even though continued for a long time. Thus setting out with a chemical and mechanical process I have succeeded in performing all the operations by chemical reactions and by a simple process, which is the surest guaranty of economy. Since my last certificate of addition I have added new modifications, which reduce the operations to their simplest form. The fibrous vegetable substance is wet-

ted and passed between two cylinders of greater or less power according to the substance; wood is completely crushed, straw is only bruised.

This substance is subjected to a strong alkaline solution for six hours, having 15 per cent. of potash and caustic soda. I have observed that an excess of alkali facilitates the subsequent operations; therefore I have increased the quantity, and to secure econo-
395 my I have collected the lye-water in a vat. From this vat it is conducted under a furnace in which water is usually placed, or into any other hot place; then the water is evaporated; the evaporation is promoted, if desirable, by agitation, by division; finally, by any convenient means. The residuum is a resinous deposit very alkaline, mixed with charcoal which has passed through the intermediate grate, which may have been used if desired. This dry residuum may serve like resin for making lighting gas, and the charcoal which is left is burned in the furnaces; the ashes are collected, and it is found that they contain, less the waste, all the potash and soda used. In every case the digesting being completed above the vat in which it has taken place, and which has near the bar above the bottom a metal net, and between the two a cock; there is added, I say, over the vat another metal net placed some centimetres below the edges of the vat. Above that is a water-cock, from which the water is spread over the surface of the sieve, filters through the alkaline solution, and passes out through the cock at the bottom; the cocks are closed when the water passes out pure.

The substance being washed, it is sujected to pressure and treated with chlorine or nitric acid until an alkali changes the substance black, and until the substance washed supplies a pulp uniformly of a greyish white. I have added to this operation two modifications, which, according to circumstances, may be advantageous:

1. Instead of causing the organic substance to be heated in water charged with nitric acid 10 per cent. of the substance may be placed in water charged with 15 per cent. of nitric acid, then subjected to pressure, so as to leave but two-thirds of the water in the substance, and having been thus pressed to be heated in cylinders or chambers made of sand stone or non-corrosive metal. The water obtained by the pressure may be used in acidulating new materials.

2. Instead of causing the chlorine to act upon the pure substance in common chambers, this substance may previously be charged with 5 per cent. of nitric acid; in this case there is a saving of chlorine.

In all cases the substances no longer containing any fatty and resinous substance except in a state of complete oxygenation is washed in a vat having two metal nets and two cocks like the digesting vat. Thus, as the substance is placed in this vat, this substance spreads over the metal net at the bottom, beneath which there is a cock. The vat being filled, the upper movable net is placed over it, and the water cock is opened. When the water from the lower cock runs clear there is added, after the water has been allowed to drip off, water slightly alkaline. It is allowed to drip off again; it is washed in

the same manner, a quantity of pure chlorine dissolved in water is added, which varies according as the operations have been more or less perfectly performed. The bleaching is perfect in a short time; when it is complete, the chlorine water is allowed to drip off, which may be again used, and the pulp is allowed to stand until it
396 shall have completely transformed the little chlorine which it yet contains into hydrochloric acid. If it is desired for greater precaution, the pulp may be left in a stuff chest for several days. Another means which is more simple, and which does not succeed so well, consists in washing for a long time the pulp which has been subjected to the action of chlorine and then bleaching it, without using alkaline water; in this case a white pulp is still obtained, but this process is far inferior to the preceeding. I have introduced pure chlorine in the last stage of the bleaching, because the washing is no longer necessary, as it is certain there no longer remains an atom of chlorine in the pulp, which is essential for the preservation of papers, which are to be kept a long time.

The pulp, thus bleached, furnishes a paper whose appearance is more or less glossy. To remove this brilliant substance, there is introduced into the pulp mixed with water, from 5 to 10 per cent. of pure casein dissolved in a slightly alkaline water, or from 1 to 5 per cent. of starch or becula dissolved in water by boiling. (The quantity varies according to the pulp, according as the operations have been more or less perfectly performed. In order to determine the proportion, it must be tried in the mould and in small quantities for each different pulp.) There is added, as soon as the mixture has been made, from 5 to 8 per cent. of hydrate of aluminum or of zinc recently precipitated; sometimes, but rarely, a larger quantity is necessary. The caseat of aluminum, which is precipitated in the fibre by adding to the quality of the paper, neutralizes this brilliant substance with which it combines. This appearance may also be removed by the use of powerful proportions of the white insoluble salts, pure carbonate, sulphats, or silicates of lime; but then a paper is obtained which will not be durable and which ought to be thrown out of the trade, because the caseate of aluminum while giving greater strength to the paper renders it less hygrometric and produces an effect similar to that of tanning hides by the action of aluminum upon the animal matter which they contain. All these operations being completed, it often happens that there are observed in the pulp white fibres, which remain still slightly united together, so slightly that the finger may, by a movement, divide them.

In order to render the paper homogeneous it is only necessary to place at the head of the machine a powerful picker, or better still, to place the pulp in a beating engine provided with a wooden cylinder furnished with points of the same material without plate, and to deposit the caseate of aluminum while the cylinder agitates the pulp; a metal cylinder might be substituted, but it would be of no use. From the beating engine the pulp is carried in the vat of the machine. If the operation is not perfect, if it has not entirely succeeded, it may happen that the pulp will stick when under pressure;

in this case it will be necessary to pass it between two felts before subjecting it to dry pressure.

In conclusion, the operation consists only of the following, to wit: the straw, for example, to break it between two cylinders, to place it in a vat where it is digested in an alkaline solution, and when it is washed to press it and to treat it with chlorine or nitric acid; to place it in a vat when it is washed. It is converted into pulp and is bleached; lastly, it is placed in a beating engine, in order to add the caseate of uluminum, to give it a blue tint, to size it, etc.

Exhibit XVI.

Patent for invention for ten years, dated September 28, 1840, (annulled by royal ordinance July 15, 1843,) to M. Dubochet,
397 (Vincent,) of Paris, for the manufacture of paper from filamentous materials:

According to the old process the retting (maceration) of the material was effected by means of a caustic lye, which was obtained by pounding together soda mixed with one-fourth part of lime, previously slaked with water, and by pouring upon this mixture the necessary quantity of cold water, to be afterwards boiled by means of steam. I succeeded, in this way, in rendering the material soft, but I did not sufficiently effect the solution of the gum and of the coloring materials; therefore, the manufacture and the bleaching of the paper could only take place with difficulty and imperfectly, whereby all the advantages are lost. In order to succeed it was necessary to find some reagent best suited to dissolve the gum, the starch, and the coloring matter, while affecting the least possible the substances to be preserved.

Acids possess the property of dissolving vegetable matters; but, under circumstances whereby the ligamentous substance itself would undergo a great change, it is not then necessary to think of their use.

There remain, then, the alkalies, which dissolve, likewise, vegetables of this kind; but experience having shown that potash and soda, according to my old process, did not secure satisfactory results, it was necessary to operate separately upon the gum and the starch, in order to learn the cause of their failures and to find the best solvent of these two substances. It is by experiments made for this purpose that I have ascertained the causes of failure in my former process.

Indeed, the alkalies of commerce are all in a state of sub-carbonates. Their action upon the materials to be removed is wanting in effect, and in manufacture there is no appreciable chance of success, while in a caustic state, or no longer combined with carbonic acid, the action of the alkalies, increased by water in ebullition, is immediate, without changing in a notable manner the ligneous fibre which is the element of the paper.

This being determined, it remained to ascertain the alkali whose action is the most powerful, and experience has shown that it was a caustic soda, prepared as follows: "In a cast-iron boiler there are

placed a certain quantity of the crystals of soda and the quantity of water necessary to form a solution possessing twelve to fifteen degrees strength, shown by the areometer.

398 Fire being placed under the boiler, a quantity of quick-lime, equal to about one-third the quantity of soda, is added in small quantities, at intervals of five minutes. At this moment the liquor should be raised to boiling; this should be kept up for about three hours, during which time the liquor should be maintained at the same point by adding successively the water necessary to supply that which is evaporated, and by stirring the liquid frequently with a paddle. The object of this operation is to remove the carbonic acid, which is combined with the salt of soda. The fire being removed and the liquor allowed to rest, the liquid which remains on the top is decanted by means of a syphon, or taken off with a ladle.

The deposit left should then be washed until the wash-water is tasteless, after which the products of these several washings and the first liquors are poured together in a boiler and evaporated down to twenty degrees, to be used in the following operation:

Treatment of the vegetable material.

The vegetable materials, (for example, reeds,) are placed in a vessel which can hold water enough to completely submerge them, and, in order to hold it constantly in the liquid, it is covered with a grate, which ought to be operated by a pulley; the temperature of the liquid is gradually raised. After boiling a quarter of an hour there are added to one hundred kilogrammes of material about sixty kilogrammes of caustic soda at twenty degrees, made as above described. When the material approaches a soft state, then are added two kilogrammes of quick-lime, slaked in twenty litres of water, (litre, 1.76 pint,) to render the soda caustic, which has again become carbonated in the course of the operation, and also to precipitate the portion of coloring matter held in solution in the liquid. After boiling several hours, the fibrous matter, which has been separated, is removed and allowed to drain, the liquid running off being collected. The material, being then washed in clean water, is thoroughly rinsed in water slightly charged with hydrochloric acid, to remove the lime and the soda which it may have retained.

The fibre having been drained, it is well to deposit it in a dripping-vat having a double bottom pierced with holes, in order to leach it for a certain time with boiling water, as is done with linen. In this manner the fibre is freed of some portions of gum which it holds, and which have become soluble by desiccation.

399 It has been seen that liquid from the caustic bath should be saved, to be used as follows: Before the vegetable matter undergoes its principal treatment it should be macerated in this liquid, from which the coloring matters have been previously separated by precipitating them with lime-water. Thus the several operations to which the vegetable matter is subjected, occur in the following order:

First. Primary maceration in the waters coming from the first caustic bath.

Second. Principal treatment in the caustic bath.

Third. Washing in clear water.

Fourth. Washing in water slightly charged with hydrochloric acid.

Fifth. Leeching with boiling water.

All the vessels used in these several manipulations ought to be made of cast or wrought-iron. Any vessel made of copper, zinc, or wood, even lined with lead, would be immediately destroyed by the action of the alkalies.

The boiling may be done directly over the fire or by steam. If steam be used, and it is subjected to a pressure of three atmospheres, the operation is shortened.

From the details and explanations which precede, it is evident that if my present process resembles in some respects my old process, it presents in other respects, in its elements and its combinations, differences so essential, that to them alone the success of the undertaking is attributed.

Manufacture of paper.

When the filamentous substance has been obtained by the operations previously described, it is bleached and made into paper by the processes already known.

Defendant's Exhibit XVII.

Patent for fifteen years, November 7th, 1845, to M. Roque, of Paris, for paper made from plants.

After having cut the plants at a distance of ten centimetres from the ground, they are submitted to a very strong pressure, in order to extract the water, and the fleshy and pulpy parts. The plants are then macerated in a bath of lime during eight or ten days.

They are then withdrawn and boiled for about an hour in a
400 caustic lye composed of—

Carbonate of soda	12 parts,
Lime or chloride of lime	8 "
Water	80 "
	100 "

A litre (1.760 pints,) of this liquid weakened with water, if it is more than three or four degrees of strength, is sufficient for a kilogram of the material; the same bath can be used several times by adding to it a small quantity of lye in such a way that the bath shall always have about the same strength.

After this boiling the substance being almost entirely freed from its gluten and pulp; it is washed in clear water until it is perfectly clean and flexible like hempen tow.

If it is desirable to expedite the labor of washing, and even to give the substance a slight preliminary bleaching, it will only be necessary,

after taking it from the caustic lye, to wash it in a bath of water mingled with sulphuric acid, (30 grammes for 10 litres or so of water.)

After the boiling and thorough washing the material is dried, and in this condition delivered to the paper makers, who treat it the same as paper rags, or to the manufacturers of rope and of texible fabrics, who employ it the same as hemp and flax in their various manufactures.

The boiling in lye can be omitted by allowing the textiles to ferment in a bath of lime to which sulphric acid has been added, (25 grammes to 15 litres of water or thereabouts,) for a sufficiently long time to detach or entirely decompose the fleshy and glutinous parts with which they are covered.

Then the action of the press and a thorough washing suffice to reduce the fibres to the condition in which they are to be delivered to the manufacturers.

Defendant's Exhibit XVIII.

Patent for fifteen years, February 12th, 1846, to M. Cothon Breuil, of Paris, for the employment of vegetable bark in the manufacture of paper.

Different operations that the stems of the willow and osier are subjected to.

One—Removing the bark.

The removal of the bark can take place in many different ways. The process that seems preferable to us consists in passing the stems through a kind of draw plate made up of two parts of a circle cut in metallic plates, and whose edges are beveled. Supposing these plates to be placed the one above the other, with simply the difference of the thickness of the plate, and held in this position, it can be
401 readily understood how the diameter of the draw-plate can be varied at will.

Every other process, every other combination depending upon the employment of draw plates with sharpened edges, stripping the bark from the branch passing through it, can accomplish more or less perfectly the same result; which is, to remove the bark without bruising or breaking it up, so that the fibres that it contains shall not be shortoned. We might remark that, as far as the facility of the operation is concerned, there is an advantage in choosing the time of the sap; this time is, however, that in which the fibres have the least power of resistance. We have endeavored to reconcile these two cases, and we have accomplished this by submitting the dry branches to the action of steam. By this means the branches are rendered as easy to be barked as they are in the time of sap.

Second—Preparation of the bark.

First, the material is submitted to the action of a lye of the salt of soda, (1 kilogram of the salt to 100 kilograms of the material;) then it is boiled for about five or six hours under two or three at-

mospheres of steam. Next it is placed under a hemp mill, taking care that all the parts surrounding the fibres are well crushed. Then it is washed, in panniers, in pure running water, which frees perfectly the fibres from all foreign substances that have been acted upon by the lye or the crushing mill. A second washing now takes place with soft soap (1.50 k. of soap for 100 kilograms of the material) under a temperature less elevated, and for about four hours. Finally, the operation is closed by a second washing in panniers, which precedes the drying. This takes place, sometimes in the sun, sometimes in the open air, or by any other known means.

Third—Hatcheling (literally "combing") the tow.

The tow which we have obtained from the preparations above described is submitted to a hatcheling, such as is usually given to hemp. From this there come threads, which seem to us proper to be worked just as linen and hemp are in making woven fabrics.

It may be seen that, in order not to weaken the threads nor deprive them of their tenacity, we have made our lyes very little caustic, or not at all so. So our threads are of a rather dark shade. As the bleaching of these threads, in the same way that flax and hemp are bleached, renders them weaker, it would be of great advantage to employ them unbleached. We add, that the tow resulting from this hatcheling, being freed from all foreign substances, has been easily converted by any of the well-known processes of bleaching, into a white pulp of a quality superior to that of common rags, over which these materials possess an advantage, as they have a tenacity
402 like that of hemp, without the "chenevolte," which cannot be entirely extracted from the tow of the latter plant.

Fourth.—Use of the bark for making paper without previous separation from the pellicule.

The bark stripped off by the processes previously described, or even that coming from the making of baskets, is cut into bits of 4 to 8 centimetres (centimetre, 0.39371 inch) in length. These are thrown into boiling water, and then, at the end of about an hour, after the water is decanted, there is thrown upon the material, in a boiling state, a lye, composed of 2 kilograms of salt of soda, and 1 kilogram of lime dissolved in 300 litres of water to 100 kilograms of bark. After this has boiled for about four hours, and before it is turned off, there are added 50 decegrams of sulphuric acid in 300 litres of water. A half hour after this, this first operation is ended, and the material is placed in a covered tank, where it is left to macerate for forty-eight hours. It will be sometimes preferable to let the material remain for twenty-four hours before withdrawing it, and in place of putting it in the tank.

The material thus treated is passed to the cylinder for tearing it in shreds, taking care to have the cylinder move but lightly over the plate, to unravel it, in order to open the material without breaking it, for the purpose of detaching from it the pellicules, the paren-

chyme, the dirt, the gluten, and anything except the fibres. A thorough washing of an hour accomplishes this, and we thus obtain a beautiful tow, that can be torn up by the same cylinder, and then carried to the refining cylinders.

The material is then put in the tubs, and pulp is obtained of a superior quality, although of a dark color. When it is desirable to make white paper with this same pulp, it is pressed and bleached in the same manner as rags.

5th.—Use of the branches or stems of the willow and osier, with or without the bark, for making paper pulp.

The operations for treating with lye and for washing are the same as those for the bark alone; but, since the wood offers more resistance to the crushing than the bark does, it is necessary in this case to use a stamping or rolling mill, in place of the hemp mallets.

It can be seen that the dark color of the bark would make it preferable to use only the wood from which the bark has been stripped, unless the smaller branches of the willow and osier were used, from which it would be difficult to strip the bark, or rather whose bark would not be in the least prejudicial to the use of both wood and bark together, which is the case when the branches and shoots are quite young, of whatever size they may otherwise be.

6th.—Extraction of coloring material from the above-named barks.

The waters of the lye and washings are collected, and there is added a quantity of liquid acitate of lead. From this we have obtained a considerable precipitate, forming a sort of red chromate, good for coloring, and that constitutes a new product, hitherto not obtained from these barks.

Brevet d'Invention, new series, vol. 10, p. 94, 2,666.

Defendant's Exhibit XIX.

Patent for fifteen years, March 20, 1847, to M. Gros, of Batignolles, (Seine,) for the employment of broom in the manufacture of paper.

The broom plant can be converted into paper pulp at all seasons; at the moment when it is harvested, or a long time afterwards; when it is in any stage of greenness or dryness. It is, however, proper, in order to avoid the great waste attendant upon an abundance of sap, to stop harvesting the broom during about four months in the year; for example, from 1st of May to 1st of September.

The broom, in just the condition in which it is taken from the soil, entire, and without assorting or casting aside any of it, without there should be any dead wood, is first to be submitted to a powerful crushing, which can be given through rollers or any other equivalent apparatus suitable for crushing the plant without cutting or breaking it up too much. These rollers can be smooth, grooved, or fluted. If the plant has arrived at the dry condition in which it is

brittle, it will be necessary to make it supple by wetting before it is crushed.

This crushing has for its object the reduction of the entire plant to a uniform condition, by bringing the wood itself to a kind of fibrous condition, so that all the parts of the vegetable are alike ready to receive in the same manner, by lyes or otherwise, a simultaneous and equal softening.

403 If the plant, after having passed once through the rollers, does not seem to be sufficiently crushed, it can be run through the rollers a second time, and more times even, bringing the rollers nearer together each time. After a sufficient crushing the bark from the larger or middling size is removed as much as possible. This wood, deprived of its bark, is laid aside to be used, as will be hereinafter described.

All the other parts of the plant, small and inferior sized broom, from which the bark could not easily be taken, as well as all the bark taken off, are placed together upon a crushing or rolling floor, smooth or more or less fluted or grooved, and made of stone, wood, or any hard non-metallic substance. This floor is to be provided, on all sides, with a curb to retain the water, which could then be drawn off at will. A roller of stone, wood, or any material except metal, either smooth, grooved, or fluted, and of a weight which can be conveniently increased or diminished at will, by the introduction into each end of slugs of cast iron of greater or less weight. This roller is now, by a direct forward and backward movement, moved over the material that has been previously wetted with spring or river water, either cold or more or less hot, or even with warm alkaline water. This operation, the object of which is to break up and reduce to fine particles, and, as a consequence, detach the soft, gummy, resinous parts and coloring matter of the plant, as well as also the epiderm or parenchyme, which adheres between the filaments composing the bark, should be continued until the water with which one waters the material, and which is constantly renewed shall come away clear, after having rested awhile upon the floor. The substance will then have the appearance of tow of a more or less gray, yellow, or green color, according as there has been used for wetting it either cold, warm, or alkaline water.

All this material must be reduced by being cut up into bits of about ten or fifteen centimetres in length.

Thus crushed, broken, cleansed, and cut, the material must be submitted, either immediately as it comes from the floor, or later at any time desired after it has been dried to preserve it, to a lye of lime, with or without the addition of salt of soda or of any of the alkaline salts, according to the quality of the pulp that is to be made. This treatment with lye should continue from four to twelve hours. The season during which the broom has been gathered, and the quality that is desirable for the pulp, will determine the time of this treatment, as well as the nature and quality of the chemical agents that enter into the composition of the lye. For a coarse pulp, fit only for making wrapping paper, about four hours in this lye, com-

posed of ten per cent. of volume of lime water, with constant boiling, will suffice for broom gathered in spring and summer. But for broom gathered in the autumn and winter, six or eight hours of this treatment will be needed in a lye composed of fifteen per cent. of lime water.

For a pulp intended for various qualities of white paper this treatment must last for six or eight hours in spring and summer, with about ten per cent. of volume of solution of salt of soda and five per cent. of lime, and the same operation continue eight or twelve hours for broom gathered in autumn and winter, composing the lye[a] of about fifteen or twenty per cent. of volume of water of salt of soda, rendered caustic by about five per cent of lime.

The broom is put into this lye when it is in full ebullition, and after the soda and lime have been introduced and dissolved.

The material should then, before it is washed, and just as it
404 comes out of the lye, be placed one side and piled up, to remain in that condition during fifteen days, after which it should be put in the cylinder to be washed until the water comes away clear. The machine should be a little crowded from the edge, and not more so than when the material is being picked to pieces, and only a little by little.

The wire cloths of the washing-drums, and the other gratings which serve for the passage of the water from the mass, should be much larger than those which are used for washing rags, so as to facilitate the expulsion of parts that are neither wood nor fibre.

After the tearing in threads, (or unraveling "efflochiage,") the material is pressed so as to free it by this means from all the water possible.

If the pulp is to be used for packing or folding-paper, it is necessary, after having divided it up in shreds, when the water has been run off from the mass and the pulp is only drained, that is to say, about two hours after it is taken from the cylinder, to put the pulp in a wooden vessel and wet it, that is to say, soak it only with chloride of lime, such as is used in paper making. It will be advantageous to stir up the material with spades, or anything suitable. About twelve or even twenty-four hours after this pulp can be washed and refined.

When the pulp is to be employed in the making of white paper it is necessary, after having pressed it as described above, to divide it into parcels and place it in boxes with chlorine gas. There is made then the most perfect vacuum possible, with a pneumatic apparatus; the gas is introduced afterwards. When the material has remained there a sufficient time, it is to be washed with care, and there are cases—as, for example, in obtaining pulp of a most perfect whiteness—when it will be useful to submit the material, as in the first instance, to a second and even to a third action of the chlorine gas, taking care to wash it well after each bleaching, as well as also to press it.

[a] Lessive avec environ 15 a 20 p. ct. du volume d'eau de sel de soude rendu caustique, avec environ 5 p. ct. de chaux grasses.

The operation is finished, as with rags, by a bath of chloride of lime, which is kept up until it seems sufficient for the desired effect. The action of the chlorine has always an excellent effect in dividing and disintegrating the broom, and giving to the pulp that is made of it a great degree of the felting property. The material can stay quite a long time in this acid without losing any of its good qualities.

On coming out from the chloride of lime the pulp is washed, and has no need of any further refining before it is made into paper.

As to the wood, from which the bark has been taken, that was to be set aside after the rolling, this to be placed in lye in a closed vessel, with a pressure of about three or four atmospheres. This lye is to be made in the same way as that described above, and should act upon the material the same length of time. After the treatment with lye, the wood is to be immediately placed, without washing, upon the crushing floor, and crushed with the roller until it looks like a textile material torn in shreds. After that it is to be a second time and in like manner treated with lye, then washed well in the cylinder, and afterwards torn up finer than rags are; then pressed, submitted to chlorine gas, washed, and refined. After this last operation, one can either mix the wood with other white pulps or use it alone, to make of it a paper that shall be peculiar for its silky fineness and the satin-like appearance that it will present, without having been submitted to a polishing or to the action of any thing to make it smooth.

Other different processes pertaining to the art of paper making can be equally well employed, and with success, in obtaining good paper pulp from the broom alone.

It would be superfluous to mention these, as well as to state that these pulps from the broom can be, with advantage, mixed with all the varieties of pulp paper fit for making paper.

The fibrous and textile qualities of the common broom have been a long time recognized. In some countries a tow is made from it that is used in making coarse cloth. This tow, as well as the cloth made of it, can, as well as any other like material, be employed in making paper more or less coarse. But that which especially distinguishes the invention that forms the subject of the present description is the facility of manufacture (by the employment of means either new or newly applied, with a hand-labor not more burdensome than that expended in using raps) from the common broom, if a pulp fit for making all kinds of paper, which alone constitutes a good industrial operation, which no other person, save the inventor undersigned, has been able, up to this time to accomplish.

Exhibit XX.

A. D. 1843. No. 9,787. Machinery or apparatus for bleaching fibrous substances, and manufacturing the same into paper.

Wright's specification.

To all to whom these presents shall come, I, Lemuel Wellman Wright of Gresford Cottage, North Wales, engineer, send greeting:

Whereas, her present most excellent majesty, Queen Victoria, by her royal letters patent under the great seal of Great
406 Britain, bearing date at Westminster, the fifteenth day of June, one thousand eight hundred and forty-three, and in the sixth year of her reign, did, &c., &c., &c., for herself, her heirs, and successors, give and grant unto me, the said Lemuel Wellman Wright, her especial license, full power, and sole privilege and authority, that I, the said Lemuel Wellman Wright, my executors, administrators and assigns, and such others as I, the said Lemuel Wellman Wright, my executors, administrators, or assigns, should at any time agree with, and no others, from time to time, and at all times during the term of years therein expressed, should, and lawfully might, make, use, exercise, and vend, within England and Wales, and the town of Berwick-upon-Tweed, and in all the Islands of Jersey, Guernsey, Alderney, Sark, and Man, and also within all her majesty's colonies and plantations abroad, my invention of "certain improvements in machinery or apparatus for bleaching various fibrous substances," and also an invention of "improvements in machinery or apparatus for converting or manufacturing the same into paper," (partly communicated to me by a foreigner residing abroad,) in which said letters patent is contained a proviso that I, the said Lemuel Wellman Wright, shall cause a full and particular description of the nature of the said invention, and in what manner the same is to be performed, to be enrolled in her majesty's high Court of Chancery within six calendar months next and immediately after the date of the said in part recited letters patent, as in and by the same, reference being thereunto had, will more fully, and at large appear.

Now know ye, that in compliance with the said proviso, I, the said Lemuel Wellman Wright, do hereby declare that the nature of the said invention, and the manner in which the same is to be performed, is particularly described and ascertained in and by the drawings hereto annexed, and the following explanation thereof, that is to say:

These improvements in machinery or apparatus for bleaching various fibrous substances consist—

Firstly. In the novel arrangement andconstruction of the several parts of the machinery or apparatus employed, and in the application of the ssme to the process of bleaching straw and other fibrous substances, (such as wheat, oat, barley, or rye straw, and jute wood, commonly called surat,) to be used for the manufacture of various kinds of paper, millboard, cardboard, button board, &c.

Secondly. In the particular machinery or apparatus for washing and cleansing all the dirty or extraneous matter from the straw or other fibrous substances.

Thirdly. In the peculiar adaptation of the machinery or apparatus used or employed for reducing the same into a state of pulp.

Fourthly. In the continuation of the washing of the fibre in the pulpy state, and in the peculiar apparatus or machinery employed for the purpose of boiling the same by high pressure steam.

And fifthly. In the machinery or apparatus for washing from the boiling process, for performing the scouring, chloride, or other chemical processes, and thus perfecting the operation of bleaching the pulp ready for use, as hereinafter described.

The improvements in machinery or apparatus for converting the same into paper, apply more particularly to that construction or arrangement of paper making machinery for which letters patent were granted to me by his late majesty, William the Fourth, bearing date at Westminster, the fifteenth day of November, one thousand eight hundred and thirty-four, the specification of which was duly enrolled in the Rolls Chapel Office, and to which I shall hereinafter refer, as may be required.

In order that the present improvements may be fully described, and shown in detail, I have attached to these presents three sheets of drawings, the first of which represents the machinery or apparatus for bleaching and preparing the straw or other fibre, and drawn upon a scale of about one quarter of an inch to the foot; the second and third represent the improvements in the machinery or apparatus connected with the manufacture of paper from the said fibrous pulp.

Description of the drawings.

In sheet 1, fig. 1, is a longitudinal elevation of the bleaching apparatus, being drawn mostly in section, to show the working of the process more clearly, and fig. 2 is a plan view of the same, as seen from above, in which I have shewn a set of the apparatus arranged; similar letters of reference are marked upon corresponding parts of the apparatus in both the figures. The tub or vessel A is for the purpose of mixing lime and water together, commonly called solution of lime, or "milk of lime." Steam is admitted into this tub by the pipe *a* for the purpose of boiling water, is admitted as
407 required by the pipe *b*, and the top and the pipe *c* are for the purpose of drawing off the lime liquor into the tubs B B. These tubs or boiling vessels may be made of wood or metal, and are intended to contain the straw or other fibre, in which it is to be boiled with the lime liquor previously prepared. The said tubs to be covered down with lids and made steam tight, with safety-valves, which boiling process should continue for about twelve hours. *d* is the steam pipe for boiling the contents of the vessel; *e* the pipes for admitting water, which may be previously heated in the two auxiliary vessels *f* and *g*. The pipe *e** is for the admission of cold water,

if required; and *h h* are the pipes and valves for drawing off the straw or fibre and liquor into the washing tubs C C when sufficiently boiled. The tub C is for the purpose of washing the lime and coloring matter from the straw or fibre, and is provided with a false bottom, covered with wire gauze or cloth of about No. 12 mesh, (in order that the fibre may be retained in the tub,) when the water is drawn off by the pipe *i*; and it is also furnished with an agitator, kept in continued motion by means of its driving gear, drum, and strap *k k*, which will prevent the wire cloth from being choked or filled up by the lime powder, as well as keep the whole mass in action during the washing process. Water is admitted as required by the pipe *l* and drawn off by the pipe *i*. After being well washed and cleansed, the straw or fibre has to be removed from this vessel, and submitted to the grinding or pulping apparatus D D, conveniently attached. Each machine or apparatus is composed of two large cast iron rollers *m*, *m*, *m*, *m*, of about five feet diameter, and about five tons weight, each roller revolving on a stationary axle *n*, *n*, *n*, *n*, properly secured in the framework, and bearing or rolling by friction of contact upon the bottom circular iron plate, bed or trough *o*, *o*, *o*, *o*, which is caused to revolve by means of the bevelled teeth, cast or fixed in segments upon the undersides, being driven by the pinion and shaft *p p*, and supplied with water as required by the pipe *q q*. The boiled staw or fibre from the tub C is now to be thrown into this trough or bed, and under the rollers to which it is conducted by guides *s**, *s**, *s**, *s**, and is allowed to remain under the grinding action of the rollers about fifteen minutes, more or less, as the nature of the material may require, until the pulping process will be completed, when the pulp may be taken out from under the rollers and placed into the tub E, which is of the same construction, and used for a repetition of the same purpose as the tub C, with this exception only, that the wire cloth constituting the false bottom of this tub must be of a finer texture; that is, about No. 30 mesh.

The pipe and tap *r* from this tub is intended for drawing off the waste water with the coloring matter that passes from the pulp during the process of wasting, the pipe *s* at the same time admitting pure water. After this second washing, the pulp is to be passed through the pipes and cocks *t t*, into the close iron kiers F F, wherein it is to be boiled again in lime water, commonly called "milk of lime," as before, for about six hours. These kiers have steam-tight covers, safety valves, and man holes. *u* is is the pipe admitting steam for boiling; and *v* a water pipe for drawing water into the kiers. When the pulp has thus been boiled for six hours, the steam must be shut off from the pulp *u*, and introduced above the liquor by the steam pipes *w w*, which will bring the pressure of the steam upon the top of the pipe, and when the tap *x* is opened in the bottom pipe *y*, the pulp and liquor will be forced up the pipe *z*, and discharged into the tubs G G, where it is to be
408 washed again, and in the same way as before described, excepting, in this case, the bottom of the tub is covered with fine pierced or perforated sheet lead, of about four pounds

weight to the square foot. The pulp now being in the tub G, G, must in this stage be well washed and agitated with water, constantly running in at the pipe 1, and drawn off as required at the pipe 2. When sufficiently agitated in this vessel, the pulp must be submitted to the action for two hours (still kept in motion) of a solution of sulphuric, muriatic, or other acids, of the ordinary strength used for bleaching purposes, washed as before until the acid is all removed from the pulp, when it is to be returned by the pipe 3 into the close kiers F, when it must be boiled again in a solution of alkali of 2° No. 1 hydrometer, which should be continued for about four hours, or until the strength of the alkali is spent, when the pulp and alkaline liquor are forced back into the tub G again and washed, as before described. The washing being competed, the pulp is to be agitated to a solution of chloride of lime, or bleaching liquor, (of the ordinary bleaching strength.) for about two hours, and then the solution is to be brought to the boiling point by the admission of steam into the tub; after the chloride or bleaching liquor is entirely spent, the pulp and liquor are let down through the pipe and valve 4 into the tub H, when washing must again be performed therein, and when the chloride or bleaching liquor is all washed out, it must be submitted to the process called souring, consisting of an immersion in a solution of acid and water, where, after being agitated for about four hours, the whole is to be let off through the pipes and valves 5, 5, into the tubs I, I, below, where it may remain until the next batch is ready for "souring." The "souring" liquor is to be pumped up the pipe 6 into a tub above to be ready for use again as required; the pipe 7 is for a supply of fresh water when wanted, and the pipes 8 and 9 are for drawing off the "souring" liquor when spent and of no further use. After the working of the whole of this improved bleaching machinery or appuratus, as above described, the straw, pulp, or other fibrous material will be perfectly bleached, and fit for the subsequent manufacture of white paper. But I would remark, in conclusion of this part of my specification, that when the pulp is not intended to be used for white paper, the preparing process may be discontinued after the boiling of the pulp in the close kiers F, F, prior to its
409 being carried into the tubs G, G; and also, that after the pulping and bleaching processes have been completed, as above described, the pulp may be submitted to the ordinary rag engine for an hour or so, for the purpose of washing, blueing, and clearing the stuff prior to its introduction to the paper machine.

In sheet 2, Fig. 1 is a sectional elevation of an improved paper-making machine, with sizing and cutting apparatus attached; and Fig. 2 is an elevation of the delivering end of the paper machine. In sheet 3, Fig 2 is a plan or top view of the paper machine, with a sizing and cutting apparatus complete, and Fig. 2 is a longitudinal elevation of the same. The pulp leaves this vessel by a trough, and is raised by means of an ordinary bucket-wheel or elevator in the box D, and forced along the trough E into the vat F, in which the moulding cylinder G revolves. In this improved construction of paper-making machine, the moulding cylinder G, for making the continuous

length of paper, and the adaptation thereof, and the mode of regulating the quantity or thickness of the paper produced, together with other general arrangements of the machinery, are exactly similar to that described in the specifiation of my former patent of one thousand eight hundred and thirty-four, which it is necessary here to repeat, in order that the application of the present improvements may be properly understood; that is several wheels or drums are first made fas upon the axle or shaft of this cylinder G, which are placed at from three to four inches apart for the purpose of giving stability to the ribs which are to form the cylinder, the two outer or end rings being made with strong flanches. When these wheels have been fixed on the shaft, longitudinal wires or round bars of metal about one-quarter of an inch in diameter are attached to the after parts of the rims of the wheels, parallel to each other, and in the direction of the axle, at about a quarter of an inch apart. The rods bear in notches in the peripheries of the wheels, their ends being passed through holes in the end flange rings, and they are drawn tight by screw nuts or riveted at the outside of the flange rings. These ribs having been secured to the flange rings, and thereby made to perform a cylindrical cage, a continuous wire, about the sixteenth of an inch in diameter, is then tightly wound around the periphery of the cylinder in the direction of a spiral or screw in order to hold the longitudinal bars firmly in their places in the notches of the peripheries of the wheels. Over this spiral wire round the cylinder is to be a covering of woven wire or wire cloth, having about eighteen meshes to the inch, which wire cloth is to be fastened in the usual way of securing wire cloths upon paper making cylinders, and over this wire cloth a covering is to be put of fine vellum wire cloth, adapted to the kind of paper intended to be made; one end of this cylinder is to be closed water tight, the other end being open for the free passage of the water between the arms. A cylinder constructed as described is represented in the drawing, in connection with a machine for making a a continuous sheet of paper, with the drying, sizing and cutting apparatus. The moulding cylinder G is mounted in the vat F, F, the end of its axle turning in bearings fixed on the edges of the vat. Paper pulp, prepared in the usual way, is to be supplied to the vat and kept at kept at one uniform height by an overflow trough during the operation of making paper by the ordinary means, the moulding cylinder being immersed to the depth of about half or more of its diameter in the pulp. The open end of the cylinder is made to work water-tight against the side of the vat. The reason of packing one end of the cylinder and closing the other end is, that no water shall pass from the vat into the cylinder except through the wire cloth round its periphery. Near the lower part an aperture is made through the vat to the discharging trough E, E, which aperture communicates with the interior of the cylinder G for the purpose of drawing the water therefrom. This aperture has a sluice shutter cock or valves, to limit the flow of the water from within, and thereby to regulate the hydraulic pressure on the outer or moulding surface of the cylinder, and thus determine the thickness of the paper by regulating the

deposit of pulp thereon. The moulding cylinder is intended to revolve in the direction of the arrow; it is moved by the friction of the travelling endless web or felt H, H, passed round the couching roller I, between the pressing roller K, and the drying cylinder L. This drying cylinder or the pressing roller may be put in motion by wheel gear or straps applied to the end of its axle. After the formation of paper by the deposit of pulp upon the cylinder G, the water is passed from the interior of the cylinder by means of the trough E, to the pulp dresser or strainer C and the elevator. The paper is now taken up by the felt by the action of the couching roller detaching the paper from the moulding cylinder, and conducted between the pressing cylinder K and the drying cylinder L. The drying cylinder L is an improvement upon my former plan, and consists in the introduction of a large metallic cylinder L (say of cast iron, and made hollow for the purpose of being heated by steam or otherwise,) and the paper is passed nearly all round this cylinder between the pressing rollers K, K, and steam-heated smoothing rollers M, M, all being driven by friction of contact with the drying cylinder, which imparts a peculiar and highly finished surface to the paper. The fibre is in consequence compressed or consolidated, adapting it for writing with ease and dispatch, and when used for printing purposes it yields a clear impression with less power. As the paper is dried and finished, it is conducted from the drying cylinder by the small roller N, just in front of the doctor or clearer O, (which is for the purpose of preserving the surface of the drying cylinder free from any particle of fibre which may adhere thereto,) and passes on to the sizing machine annexed. It will be observed that the endless felt H, H, runs in a box of water P, for the purpose of being washed, without stopping the machine, which is also provided with a revolving beater Q, acting against the back of the felt as it travels through the water. A stretching apparatus R, R, is also provided for the felt, whereby it is tightened or slackened by the elevation or depression of the roll R in its groove, and acted upon by the chain S, fixed at each end of the roll, passing over a pulley above and communicating with a catch or ratchet wheel below. The paper now passes into the sizing machine over the conducting roller T. U is a brass roller, placed in a horizontal position in the side frames, and pressed by means of set screws against the wooden roller V, each roller being furnished with a doctor or clearer. The size is raised by means of a pump from the cistern W, and discharged into the space or trough formed by the contact of the two rollers, and means of gates or boards fitting tightly against the end of the rollers, the size is kept to the height of the top of the roll U, the cavity containing the body of size through which the paper (shown by the blue line) passes, being thus formed between the rolls and the end gates or boards. The paper, after the sizing process, passes over the conducting roller W to the cutting machine, constructed for the purpose of simply dividing the hitherto continuous length of paper into sheets by means of a revolving cutter; it consists simply of a cutting blade X, being placed along the periphery of roller Y, and as it revolves, by acting against

the fixed or ledger blade Z, fixed above in a transverse position, over which the paper passes, cut or divide the paper into sheets as required, which fall upon the continuous felt below, and are thus delivered to the table attached. The length of the sheet is regulated by a pair of conical pulleys A*, one of which communicates with or drives the revolving cutter.

Figure 3, sheet 2, shows a mode of couching or detaching the paper from the moulding cylinder G, by the substitution of a continuous or endless web of wire instead of felting, and by which the paper is conducted to the drying cylinder. To use this wire the felt is only continued through the pressing rollers and drying cylinder. *G* is the moulding cylinder, *L*, the couching roller, *J*, *J*, the wire, *J*, a pressing roller kept against the cylinder *L* by a lever and weight, *K*, another pressing roller, *L*, part of the drying cylinder, and *H H* the felt.

In witness whereof, I, the said Lemuel Wellman Wright, have hereunto set my hand and seal the fourteenth day of December, in the year of our Lord one thousand eight hundred and forty-three.

[L. S.] LEMUEL W. WRIGHT.

And be it remembered, that on the same fourteenth day of December, in the year above mentioned, the aforesaid Lemuel Wellman Wright came before our lady, the Queen, in her chancery, and acknowledged the specification aforesaid, and all and everything therein contained, in form above written. And also the specification aforesaid was stamped according to the tenor of statute in that case made and provided.

Inrolled the fifteenth day of December, in the year above written.

W. E. LYCETT.

A Master Extraordinary in Chancery.

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Exhibit XXII.

Great exhibition of the works of industry of all nations, 1851 Official descriptive and illustrated catalogue, published at London, 1851.

"42. Wright, Lemuel Wellman & Co., 75 Cheapside, inventors and manufacturers.

"Specimens of China-grass, (Urtica nivea,) as it comes from India (Assam) and China, and in various stages from the raw material, as manufactured in India and China.

"Also flax and China-grass, as prepared in this country for spinning into yarns for finer purposes. Specimens of broadcloth, in which it is mixed with wool in various proportions. Specimens of various kinds of paper made from wheat-straw."

Exhibit XXIII.

[Translation from the Central Blatte, for German manufacturing of Paper, No. 29, Nov. 15, 1852, p. 483.]

NOTICE OF THE RAG-BOILING MACHINE OF DONKIN.

The very best machines are now set up in Germany, and one of them is at the establishment of "Henry Voelters, Sons," in Herdenheim-on-the-Brentz, ready for inspection by all visitors who pay attention to such matters.

Very many improvements have been made by the persons mentioned above and by the Benkiesers at Pforzeim, and the usefulness of the machine has thereby increased.

For rags like half-woolen and for sacking, which need to be boiled longest, one and a half to one and three-quarter hours immersion is necessary, under a pressure of one and a half atmospheres of steam.

When the steam has been shut off, the rags are left for some two hours, and at the same time are kept boiling.

At the end of this time the lye is turned off, for future use, into a kettle standing near, and cold water let in upon the rags for the purpose of washing them, which operation is very easily performed.

We have already communicated the fact that the rags need not be previously passed through the devil, nor need they have any additional washing.

We reserve still further communications upon this subject.

Exhibit XXIV.

[Translation.]

Appendix to No. 35 of the Central-Blatte, fur Deutsch Paper-fabrikation, May 14, 1852, p 15 and note.

GUSTAV SCHAUFFELEN.

He furnished at a very early date the most beautiful post and other sorts of writing paper, from which he gained considerable profit, since he had, for a long time, no competition on Germany. This made it possible for him to enlarge his manufactory to such an extent that it excited universal astonishment. He bought, by degrees, all the buildings situated near his manufactory; for example, an enormous flax spinning establishment, a fulling mill, a linen bleaching establishment with its water-works, a tannery and oil mill. He was obliged to tear down the large part of these buildings that he had bought, in order to rebuild them in such a was as to correspond with the general magnificent style of his manufactory.

He considered the water-works that he had included in the purchases as of the greatest importance. After untiring pains he at last

completed a building which, as regards its extent and advantageous mechanical arrangement, was at this time unsurpassed in Germany.

He worked three paper machines that produced daily three hundred reams of paper, and gave employment to from one hundred and fifty to one hundred and seventy persons.

His consignments extended into Swabia, the countries on the Rhine, Prussia, Saxony, Hanover, Austria, Bavaria, Denmark, Sweden, Russia, and even in England, this article found favor, as it was so well adapted to the use of steel pens. Considerable quantities were also sent to America and to Batavia.

In his workshop he manufactured, besides paper machines, book presses, steam presses, steam engines, pump, augur, and cutting machines, and all machines that were ordered of him, provided their dimensions were adapted to his accommodations.

* * * * * * * *

Schauffelen was one of those intelligent manufacturers who are never at a stand-still, but ever strive to improve and advance every branch of their industrial art.

As he was the first to bring into use chlorine bleaching of half-stuff in a more acceptable manner and in a way more conformable to science, so was he also the first to introduce, in the process of paper making, the closed iron boiler of the kind used by Papin, which he had seen during a visit to the bleaching establishments of Belgium and Holland.

This had an important and a considerable influence upon the improvement of paper through the use of a high pressure of steam which, up to this time, had never been accomplished.

Exhibit XXV.

[Translation.]

Central-Blatte, upon the manufacture of Paper in Germany, No. 27, *Sept.*, 1852, *p.* 449. *Three Communications.*

ARTICLE UPON THE MANUFACTURE OF PAPER FROM CLOTH WASTE AND STRAW IN ENGLAND.

From the notes to the official report of the London Industrial Exhibition, by Mr. William Oeschelhauser, who is well skilled in
416 the art of manufacturing paper, (at present Burgomaster of Mulheim.) For the sake of short notices we have ordered several copies and recommend them to paper manufacturers. Since the admirable manner in which Mr. O. treats of this branch of industry furnishes many supplements to our report. (Hollander.)

In England the manufacture of paper from straw, differs from that in Germany in this, that with us the reducing of the materials is accomplished more by mechanical means, while in England the straw is once or more boiled in a strong lye under a pressure of from six to

eight atmospheres, in Germany it is boiled in open vessels, and consequently almost, as it were, dissolved. In addition, crushing rollers are also used, similar to those in our oil mills, so that almost no work at all remains for the grinding mills.

L. B. Wright, of Gloucester, in Chalford near Stroud, has carried the manufacture of the better sorts of paper from straw alone to the greatest extent, using straw without any addition of rags.

By reason of the high price of rags, and the cheapness of coal, the manufacture of paper from straw has in England a more economical basis and an entirely different position from what it has with us.

For the manufacture of the ordinary kinds of paper the use of straw will certainly be upon the increase.

On the other hand, it would be useless to wish to substitute the material for paper of the finer sorts.

Exhibit XXVI.

Industrie Austellung zu London, 1851, vol. ii., p. 342, note 4, note 8.

"4. The boiling of rags is carried on mostly in closed vessels under a pressure of from two to four atmospheres. In later time various kinds of revolving kettles (revolving boilers) are used, partially in form of an upright cylinder, which, (just like the cylinders of an oscillating engine,) turns upon trunnions through which the steam
417 enters, and partially in form of two cylinders, one fitting the other, of which the outer one remains fixed and the inner one revolves around its axis."

* * * * * * * *

8. In England the manufacture of paper from straw differs from the methods that are followed in Germany in these particulars:

With us the reduction of the materials is accomplished more by mechanical means, while in England the straw is boiled once or more in a strong lye, under a pressure of steam of from six to eight atmospheres; in Germany it is boiled in open vessels, and consequently almost, as it were, dissolved.

In addition, crushing rollers are also used similar to those in our oil mills, so that almost no work at all remains for the grinding mill. (Hollanders.)

L. B. Wright, of Gloucester, in Chalford in Stroud, has carried on the manufacture of the better sorts of paper from straw alone, to the greatest extent using straw without any addition of rags.

By reason of the high price of rags and the cheapness of coal, the making of paper from straw has in England a more economical basis and an entirely different position from what it has with us. For the manufacture of the ordinary kinds of paper the use of straw will certainly be upon the increase. On the other hand it would be useless to undertake to substitute this material for paper of the former sorts.

Exhibit XXVII.

[Translation.]

Appendix to No. 34 of the Central-Blatte, fur Deutsche Papier-fabrikation, May 15, 1852, p. 15 and note.

GUSTAVE SCHAUFFELEN.

Schauffelen was one of those intelligent manufacturers who are never at a stand-still, but ever strive to improve and advance every branch of their industrial art.

418 As he was the first to bring into use chlorine bleaching of half-stuff in a more acceptable manner, and in a way more conformable to science, so was he also the first to introduce in the process of paper-making the closed iron boiler of the kind used by Papin, which he had seen during a visit to the bleaching estabishments of Belgium and Holland.

This had an important and a considerable influence upon the improvement of paper through the use of a high pressure of steam which, up to this time, had never been accomplished.

Exibit XXVIII.—Central-Blate, No. 30, December, 1852, p. 494.

[Translation.]

THE WOOD-PASTE (OR PULP) OF VOLKER.

Samples of this wood-paste, or pulp, that have lately come under our notice, show, beyond doubt, that great progress has been made and that it is not to be denied that this substitute will be of great importance in the future.

Ordinary paper from $33\frac{1}{3}\%$ parts wood-paste, and $66\frac{2}{3}\%$ rags leaves no trace to be found of any particles of wood; yet we must admit that the ordinary quality of rags improves both the appearance and feeling of the paper.

Writing paper from 20% parts of aspen wood pulp and 80% parts of waste paper and ordinary rags leaves almost nothing to be desired, since the firmness, the transparency, and the quality answer all demands.

Especially has the apparatus of Donkin, admitting of a high pressure of steam, been able to render excellent service in this respect, since already in the boiling of cotton waste and half-woolen rags, ropes, &c., &c., it has produced a much better result than the apparatus in common use at that time had been able to effect.

We believe that "Volkers Sons" in Heidenheim, on the river Brentz, will not hesitate to give to those skilled in this art, for a royalty, their patented invention and the practical use of the same.

Of this we took occasion, some time ago, to give notice to the manufacturers of paper.

419 *Exhibit XXIX.*

I. Transactions of the Society for the promotion of the Industrial Arts in Prussia. Berlin, 1846. Vol. XXV, p. 228.

II. Treatises and extracts from foreign works concerning the condition of paper making in Great Britain and France by M. Wilhelm Oechelhauser, of Siegen.

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Page 228. In France, as well as in Great Britain, are rags of all kinds boiled. In southern Germany is this process also quite common; less so, however, in northern Germany, where gas bleaching is quite generally introduced, and where the boiling is restricted to hemp and colored rags.

In general, there is everywhere among us a preference for boiling rags of all sorts, and at the same time for the use of chloride of lime bleaching, and manufacturers more and more are choosing these processes. The arrangements for boiling are the most preferable in Great Britain, where the kettles or boilers have various forms and dimensions. The same are made of cast iron, and have five and a half to six feet diameter, and are three and a half to four feet high. About six inches above the bottom is a false bottom, full of holes, upon which the rags rest. Much sand and dirt collect during the process of boiling under the false bottom, and run off with the lye when it is drawn off. When the rags are to be put in or taken out, either a part or the whole of this cover is taken off.

This closing of the boilers makes possible the use of a high pressure of steam and also the raising of the temperature, and this constitutes the special superiority of the English methods.

In France and Germany almost exclusively are the rags boiled in open kettles, and frequently the rags are held down by stone weights, and thereby the circulation of the lye hindered.

The usual pressure in England in boiling the rags amounts to five-fourths to one and a half atmospheres. The escaping or waste steam is often conducted through a bent pipe into a receptacle and is used in warming water for the next filling, or for other purposes.

420 In Great Britain the boiling is done mostly by steam; as steam-engines are in use there as a reserve power, or for increasing the water power, the waste steam is made useful for this purpose. The engines there work under high pressure. The steam is introduced by means of a pipe that extends through the cover and cylinder and under the false bottom.

Lime, soda, or potash are used in boiling the rags in Great Britain, mostly soda and lime, and often in quantities of from ten pounds crystal soda and four pounds lime for a cwt. of rags.

Exhibit XXX.—English patent. No. 836. *A. D.* 1855.

MANUFACTURE OF PAPER.

Letters patent to John Cowley, of Quennington Paper Mills, Gloucestershire, and Daniel Peyton Sullivan, of Stockwell, Surrey, for the invention of "improvements in the manufacture of paper." Sealed the 15th of October, 1855, and dated the 16th April, 1855.

Provisional specification left by the said John Cowley and Daniel Peyton Sullivan, at the office of the Commissioner of Patents, with their petitions, on the 16th of April, 1855.

We, John Cowley, of Quennington Paper Mills, Gloucestershire, and Daniel Peyton Sullivan, of Stockwell, Surrey, do hereby declare the nature of said invention for improvement in the manufacture of paper to be as follows:

The process we employ for preparing pulp, straw, and other like fibrous matters is as follows: In the first place, subject the fibrous materials to a much higher degree of temperature than has before been the practice; and we effect this either by direct application of heat, or superheated steam, or by a combination of both, by means of suitable apparatus, the object being to cause the solvent of liquor used to act more quickly and in less time. The next step is to immerse the pulp in caustic soda liquors at the low degree of from 2 to 4 Beaume, and then to cleanse and free it from impurities, and to bleach it by the use of chlorine liquors of the lowest strength
421 of 1 to 2 Beaume, applied and used with steam during the process; and lastly the paper is perfected in an engine roller of an improved construction.

Exhibit XXXI—English patent. No. 1418. *A. D.* 1855.

MANUFACTURE OF PAPER, CARD-BOARD, &C.

Letters patent to John Louis Jullion, of Combe House, Sovil, in the county of Kent, analytical chemist, for the invention of "the manufacture of paper, card, and millboard from certain vegetable productions." Sealed the 26th November, 1855, and dated the 21st of June, 1855.

Provisional specification left by said John Louis Jullion at the office of the Commissioner of Patents, with his petition, on the 21st of June, 1855.

I, John Louis Jullion, of Combe House, Sovil, in the county of Kent, analytical chemist, do hereby declare the nature of the said invention for "the manufacture of paper, card, and millboard from certain vegetable productions," to be as follows (that is to say:)

The vegetable substances from which I propose to manufacture paper, card, and millboard, are the fibres of the banana and plantain

plants, of straw, or of waste or pressed sugar canes, and of the various flags that abound in warm countries; and the mode in which I carry out the said invention is by dusting the said substances in the machine called a devil, cutting them in a common chaff-cutting box, boiling in a dilute solution of caustic alkali, with or without steam pressure, (or sulphuret of sodium or calcium may be employed as a substitute for caustic alkali,) and bleaching in the usual way with hypochloride of lime.

Another process which may be employed with advantage consists in dusting and cutting the said vegetable production as aforesaid, boiling or heating them by means of high pressure steam in a close vessel that can be set in motion, (similar to those used in the
422 manufacture of paper from rags,) with a solution of hydrate of soda or carbonate of soda, of a strength varying to suit the vegetable productions, of from 1 to 7 degrees Beaume.

Exhibit XXXII.—A. D. 1854.—*No.* 2,120.—*Manufacture of paper threads and yarns.*

Letters Patent to John Jeyes, of Northampton, in the county of Northampton, seed merchant, for the invention of "An Improve- in the Manufacture of Paper, Threads and Yarns." Sealed the 27th of March, 1855, and dated the 3d October, 1854. Provisional specification left by the said John Jeyes at the office of the Commissioner of Patents, with his petition, on the 3d of October, 1854.

I, John Jeyes, of Northampton, in the county of Northampton, seed merchant, do hereby declare the nature of this invention for an improvement in the manufacture of paper threads and yarns to be as follows:

My invention consists in the employment of the stalks or stem of mustard, and other plants of the same class, for the manufacture of paper, threads, and yarns. The stalks are boiled in a strong alkaline solution, and when to be used for the manufacture of paper are cut, torn, or broken, previous to the boiling. After the boiling the fibres are washed and placed into a pulping engine, and are made into paper. For the purpose of making threads or yarns these stalks or stems are submitted to any of the processes which flax undergoes for such purpose.

Specification in pursuance of the conditions of the letters patent filed by the said John Jeyes, in the Great Seal Patent Office, on the 31 of March, 1855.

To all to whom these presents shall come, &c., &c., I, John Jeyes, of Northampton, seed merchant, send greeting:

Whereas, her most excellent majesty Queen Victoria, by her letters patent, bearing date of third of October, in the year of our Lord, one thousand eight hundred and fifty-four, in the 18th year of her reign, did, for herself, her heirs and successors, give and grant unto

me, the said John Jeyes, my executors, administrators and assigns, should at any time agree with, and no others, from time to time, and at all times thereafter during the term therein expressed, should, and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and the Isle of Man, an invention for an improvement in the manufacture of paper, threads, and yarns, upon the condition (amongst others) that I, the said John Jeyes, by an instrument in writing, under my hand and seal, should particularly describe and ascertain the nature of the said invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the said letters patent:

Now, know ye, that I, the said John Jeyes, do hereby declare the nature of my said invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof, that is to say:

My invention consists in the employment of the stalk or stem of the sinapis alba, or mustard, and other plants of the same class, for the manufacture of paper, threads and yarns. When for the manufacture of paper, I first tear, cut, or break the stems or stalks, and boil them in alkaline solution, the strength of which varies according to the quality of the plant, in a boiler made to revolve vertically, and in which the stems are subjected to high pressure steam for about two hours, more or less, according to the strength of the alkaline solution, when the fibres will have become separated. By the employment of a rotary boiler, a smaller quantity of solution will be found sufficient than if any other form of boiler were used. On being removed from the boiler the fibres are washed, next submitted to an ordinary pulping machine and reduced to pulp, after which the pulp is made into paper by any of the processes ordinarily followed for such purpose. For the manufacture of threads and yarns the stalks or stems are submitted to any of the processes which flax undergoes for being manufactured into threads and yarns.

And having now described the nature of my said invention and in what manner the same is to be performed, I declare that I claim as my improvement in the manufacture of paper, threads and
423 yarns, the making of the same from the stalk or stem of the mustard, and other plants of the same class, in the manner hereinbefore described.

In witness whereof, I, the said John Jeyes, have hereunto set my hand and seal, this thirtieth day of March, one thousand eight hundred and fifty-five.

[L. S.] JOHN JEYES.

Exhibit XXXIII.—Patent of Coupier & Mellier, August 2, 1858.

The U. States Patent Office to all persons to whom these presents shall come, greeting:

XVI. This is to certify that the annexed is a true copy from the records of this office of the letters patent granted Jean Theodore

Coupier and Maria Amedee Charles Mellier, August 2, 1853, No. 9,910.

In testimony whereof, I, D. P. Holloway, Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed, this fifth day of December, in the year of our Lord one thousand eight hundred and sixty-two, and of the independence of the United States the eighty-seventh.

[SEAL.] D. P. HOLLOWAY.

No. 9,910.

The United States of America to all to whom these letters patent shall come:

Whereas Jean Theodore Coupier and Maria Amedee Charles Millier, of Paris, France, have alleged that they have invented a new and useful improvement in the manufacture of paper stuff, which they state has not been known or used before their application, have made oath that they are citizens of France, that they do verrily believe that they are the original and first inventors or discoverers of the said improvement, and that the same hath not, to the best of their knowledge and belief, been previously known or used, have paid into the Treasury of the United States the sum of three hundred dollars, and presented a petition to the Commissioner of Patents signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose: These are theretofore to grant, according to law, to the said Jean Theodore Coupier and Marie Amedee Charles Mellier, their heirs, administrators, or assigns, for the term of fourteen years, from the seventh day of May, one thousand eight hundred and fifty-one, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said improvement, a description whereof is given in the words of the said Coupier & Mellier, in the schedule hereunto annexed, and is made part of these presents.

In testimony whereof, I have caused these letters to be made patent, and the seal of the Patent Office has been hereunto affixed.

Given under my hand, at the city of Washington, this second day of August, in the year of our Lord one thousand eight hundred and fifty-three, and of the independence of the United States of America the seventy-eighth.

[L. S.] ROBERT McCLELLAND,
Secretary of the Interior.

Countersigned and sealed with the seal of the Patent Office.
CHAS. MASON, *Commissioner of Patents.*

The schedule referred to in these letters patent and making part of the same.

[Here follows map marked page 423.]

To all to whom these presents shall come:

Be it known that we, Jean Theodore Coupier and Marie Amedee Charles Mellier, of Paris, in the republic of France, have invented a new and improved method of reducing fibrous vegetable substances to pulp fit for the purpose of making white paper, and that the following is a full and exact description thereof, reference being had to the accompanying drawings, which make part of this specification:

Our process consists, in general, in the treatment of straw and all crude or raw herbaceous matters with a solution of hydrate of soda or potash, of such strength and in such a manner as will, together with the other means hereinafter described, reduce them to pulp, and thereby dispensing almost entirely with machinery, as commonly employed for similar purposes.

This process is simple, efficacious, and economical, but the success depends entirely on the strength of the liquor employed and the purity of the hydrate of soda or potash, for we have discovered that usually, in attempts hitherto made to obtain pulp from such materials and to bleach the same, the failure has been in part owing to the presence of lime, (a very common occurrence,) in the solution of soda and potash. Where lime is present the pulp will always retain a yellowish or dingy color.

We are aware that alkalies have been used before for treating vegetable fibres, but in such cases the alkalies have either not been employed in their caustic state, or the lime which has been present has rendered every such attempt to make white paper from straw entirely unsuccessful. Straw, or such like vegetable matter, is to be cut up by a chaff cutting-machine before proceeding to operate according to our invention, and if bark, or such like vegetable matters are to be employed, the same is to be cut into chisses or crushed, and such vegetable matters are then to be treated according to our invention, which commences with a process of employing a boiling solution of hydrate of soda or potash; and it is important that the solution should be of considerable strength; and we have found a solution of hydrate of soda or potash marking from eight to ten degrees of Beaume to be the best strength, and we would state that a material departure from that strength, either above or below,
424 will result in a failure to obtain the beneficial operation which is consequent on the use of such alkaline solutions as herein described.

The straw or vegetable matter is to be put into an open tub or vessel, as seen in the accompanying drawing A, with a false bottom shown in dotted line B B B B, perforated with numerous small holes. This tub or vessel is covered when the process is being carried on. Through the cover there is a pipe G with a rose-head I and L thereon, the other end of such pipe descending into a close iron

vessel E, and nearly to the bottom thereof. In this iron vessel, which is capable of containing about sixty to seventy gallons, the alkaline solution is to be placed, and, by means of high pressure steam from a suitable steam boiler passing through a worm or coil F, in the iron vessel E, the liquor is boiled, and by a slight escape of steam from the worm, is to be forced up the pipe G, and through the rose head I and L, by which streams of the boiling liquor will be forcibly thrown on the straw or vegetable matter lying on the false bottom of the tub A. When one filling of the iron vessel has been forced into the tub and distributed over the vegetable matter therein, the iron vessel is again to be filled, and such further quantity is to be forced over and through the rose-head I and L by the steam, when the iron vessel is to be again filled and again emptied by the steam, till the quantity of alkaline solution proper for the quantity of vegetable matter in the tub has been forced by the steam into the tub. It should be understood that the steam is shut off from the iron vessel before running in fresh quantities of the alkaline solution. When the whole of the liquor required has thus been forced into the tub containing the vegetable matter, a circulation of the liquor is to be caused to take place in the following manner: the stop-cock D on the pipe R, hereinafter described, to be opened, and to remain open during the circulation.

From the bottom of the tub A, raised some few inches above the top of the iron vessel E, proceeds the pipe R with the stop-cock D. This pipe has on its end, which enters the vessel E, a self-acting valve M opening into the iron vessel, by which a quantity of the liquor is run back into the said iron vessel E, the steam being turned off for a time to allow the entering of the liquor, and to be again turned on to drive over the liquor, the valve closing by the pressure of the steam, and preventing the liquor being forced under the false bottom while it is being forced up through the pipe G upon the straw; and this process of circulation is to be continued for about eight or ten hours, when the stop-cock D on the pipe R is shut, and the liquor is to be drawn off by another pipe C at the bottom of the tub A; water is then to be run into the close iron vessel, and is to be forced out therefrom by steam through the pipe G and rose-head, as explained, and on to the straw or vegetable material in the vessel, and such processes of wash-waters are to be repeated till the water coming off through the pipe C does not indicate a greater strength than one degree of Beaume; cold water is then to be run into the tub from any convenient source till it comes off clear.

The quantity of alkaline solution employed by this means is at the rate of about thirty to forty gallons of the strength above mentioned, for each hundred weight of vegetable matter.

The vegetable material being well washed, as above described, is then put into a bath of hypochlorite of allumina, (in order that it may be bleached and the fibres loosened,) where it remains for twelve to eighteen hours, being stirred from time to time. The hypochlorite is used at the rate of about twenty-five per cent. by weight of the vegetable matter, using about seventy gallons of water for each hun-

dred weight of vegetable matter; the solution of hypochlorite of allumina will therefore be of a strength of about three degrees of Beaume, and we prefer to employ a stronger solution rather than a weaker one. This degree of strength we have determined, after many experiments, as being the only one which will produce a uniformly white pulp, from the material prepared as above described, and to to our knowledge this solution of hypochlorites was never
425 used at the degree as we have indicated above, for bleaching straw and other vegetable matter.

In all patents which have been granted for making paper from said vegetable matters, the bleaching liquor has never been mentioned at such a high degree as it is used by us.

The strength at which bleaching liquor is employed in the ordinary mode of making paper, varies from one-fourth to one-half of a degree, when it is diluted in the necessary quantity of water contained in the engine.

We would also remark, that although we prefer to use hypochlorite of allumina, a solution of other hypochlorites of like strength may be used.

The vegetable matter, which is now reduced into what is called half-stuff, and of good color, is to have the liquor strained off. This pulp is to be well washed, (by preference in boiling water, in order completely to remove the hypochlorite, and complete the disaggregation of the fibres,) and there it remains to beat it in the ordinary beating engines, and to make it into paper alone, or in combination with the pulp obtained from rags. In order to carry out our invention as economically as may be, we cause the alkaline liquor drawn off, and the first wash-waters to be evaporated, a resinous soap is thus obtained, which, being mixed with charcoal dust, or sawdust, or alone, produces a fuel from which may be obtained gas by destructive distillation in the ordinary manner, or the same may be burned as fuel, and from the ashes by lixiviation, a considerable part of the alkali will be obtained for further use.

We must observe that the above-described process is also applicable to flax, waste cotton, waste tow of hemp, jute or surat, but this does not dispense with reducing them into half-stuff by the means usually employed.

The important features of our invention are, first, the employment of the pure hydrates of soda or potash in the reduction of the straw and similar vegetable matters into pulp, for the especial reasons set forth above, and using such hydrates at or about the degree of strength mentioned, viz, eight to ten degrees Beaume.

Second. The manner of using such hydrates upon the straw or other similar vegetable matters, by means of the apparatus above described, or other substantially the same; and—

Third. The employment of the hypochlorites of the degree of strength, viz: three degrees Beaume for bleaching the pulp obtained by our process.

We do not claim as our invention the use of alkalies in the treatment of vegetable fibre for the preparation of paper pulp, nor do we

claim the individual parts of the apparatus employed in our process; but what we do claim is—

First. The process herein described of reducing straw and other similar vegetable matters into pulp for making paper, said process consisting in applying and circulating the solution of the hydrate of soda or potash, in the manner above mentioned, and at or about the strength indicated, in combination with the apparatus, substantially as described, by which means we are enabled to effect the reduction of a very large amount of pulp with a comparatively small quantity of liquor, and preserve also the requisite strength in the liquor, and also obtain facility for its evaporation.

We do not claim the use of hypochlorites for bleaching pulp, but what we do secondly claim is the employment of hypochlorite in the process of bleaching straws or similar matter, when prepared as above, for the purpose of making paper, substantially as
426 herein set forth; that is to say, using them at or about the strength set forth in the specification, viz, three degrees Beaume, and we claim this degree of strength only when employed upon such materials.

JEAN THEODORE COUPIER.
MARIE AMEDEE CHARLES MELLIER.

Witnesses:
S. G. GOODRICH.
W. S. CHASE.

Exhibit XXXIV.—A. D. 1853.—*No.* 1,942.

DISINTEGRATING AND PULPING VEGETABLE SUBSTANCES.

Letters patent to Chas. Watt, Brompton, and Hugh Burgess, of 7 Percy street, Bedford Square, both in county of Middlesex, for the invention of improvements in disintegrating and pulping vegetable substances. Sealed the 27th Oct., 1853.

Provisional specification left by the said Chas. Watt and Hugh Burgess at the office of the Commissioner of Patents, with the petition, on the 19th of August, 1853.

We, Chas. Watt, of 15 Selwood Place, Old Brompton, and Hugh Burgess, of Percy street, Bedford Square, both in the county of Middlesex, do hereby declare the nature of our invention for improvements in disintegrating and pulping vegetable substances to be as follows:

This invention has for its object better means than those at present practiced for disintegrating and pulping vegetable substances for the manufacture of paper and other fabrics, for which purpose we take, for instance, chips, shavings of wood, or sawdust, and boil for some hours in water. A stream of sulphurous acid is passed through the mass till a partial bleaching is effected. The matters are then well washed and placed in solution of chlorine, chloric or chlorous
427 acid, called also the peroxide and protoxide of chlorine. The

matters are kept in the solution till quite white and the fibres are disintegrated. Or we employ chloride of sodium decomposed by electric agency. After the above treatment we heat the fibrous mass in warm water and dilute solution of caustic soda or potash.

Specification in pursuance of conditions of the letters patent filed by the said Chas. Watt and Hugh Burgess in the great seal patent office, on the 18th of February, 1854.

To all to whom these presents shall come, we, Chas. Watt of 15 Selwood Place, Old Brompton, and Hugh Burgess of 7 Percy street, Bedford Square, both in the county of Middlesex, send greeting.

Whereas her most excellent majesty Queen Victoria, by her letters patent, &c., &c., &c., &c. AVII. Queen Victoria, &c., &c., by her letters patent, bearing dates the nineteenth day of August, in the year of our Lord one thousand eight hundred and fifty-three, in the seventeenth year of her reign, did for herself, her heirs, and successors give and grant unto us, the said Charles Watt and Hugh Burgess, her special license that we, the said Chas. Watt and Hugh Burgess, our executors, administrators, and assigns, or such others as we, the said Chas. Watt and Hugh Burgess, our executors, administrators, and assigns, should at any time agree with, and no others, from time to time, and at all times thereafter during the term therein expressed should, and lawfully might make, use, exercise, and vend within the United Kingdom of Great Britain and Ireland, the Channel islands, and Isle of Man, an invention for improvements in disintegrating and pulping vegetable substances, upon the condition (amongst others) that we, the said Charles Watt and Hugh Burgess, by an instrument in writing under our hands and seal or under the hand and seal of one of us, should particularly describe and ascertain the nature of the said invention, and in what manner the same was to be performed and came the same to be filed in the great seal Patent Office within six days calendar months next, and immediately after the date of the said letters patent:

Now know ye, that I, the said Charles Watt, on behalf of myself and the said Hugh Burgess, do hereby declare the nature of said invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof, that is to say:

This invention has for its object better means than those at present practised for disintegrating and pulping vegetable substances for the manufacture of paper and other fabrics; for which purpose we take, for instance, chips, shavings of wood, or sawdust and boil for some hours in water, a stream of sulphurous acid is passed through the mass till a partial bleaching is effected. The matters are then well washed and placed in a solution of chlorine, chloric, or chlorous acid, called also the peroxide and protoxide of celorine. The matters are kept in the solution till quite white, and the fibres are disintegrated. Or we employ chloride of sodium decomposed by electric agency.

After the above treatment we heat the fibrous mats in warm and dilute solution of caustic soda and potash.

Having thus stated the nature of said invention we will proceed to describe the manner of performing the same. The wood or vegetable substances upon which it is intended to operate by this process should first be reduced to very fine shavings or cuttings, the finer the better. This may be done in any suitable machine. The shavings are then to be boiled in a solution of caustic alkali, the strength of which, being dependent on the nature of the vegetable substances operated on, can only be learned by experience. For deal or fir wood, we find that a solution of alkali of the strength indicated
428 by twelve degrees of the English hydrometer answers very well. The length of time necessary for this part of the process is somewhat dependent on the nature of the vegetable substance to be treated. We find boiling in a solution of caustic alkali under pressure of considerable service. We do not claim this operation as a part of our invention. The shavings are then to be well washed and pressed, and the washings may be saved and evaporated down and burned in a suitable furnace, when they are again available for the same purpose. The damp shavings are now to be exposed to the action of chlorine, or the compounds of chlorine with oxygen, till on a portion being placed id a dilute solution of caustic alkali the vegetable substance falls into a dark pulpy mass. This part of the process is conveniently effected by placing the damp shavings on racks or drawers, about nine inches apart, one above another, arranged in a chamber, and allowing the chlorine, or the compounds of chlorine with oxygen, to enter the chamber and fill it. Of the compounds of chlorine with oxygen we prefer that known as protoxide of chlorine or hypochlorous or chlorous acid or ecuchlorine. If found more convenient, the chlorine or the compounds of chlorine with oxygen may be used in aqueous solution instead of the gaseous form.

As soon as the shavings have been sufficiently acted upon by the gas, as may be ascertained by the method above described, they may be removed and the hydrochloric acid which is the result of the above process removed by washing, and the shavings well pressed. This should be done with as little water as possible, as this acid may be saved and made use of for the reproduction of chlorine. The shavings are now to be placed in weak solution of caustic alkali, when they will fall into a pulpy mass of dark brown color. This part of the process may be expedited by exposing the mass to the action of a beater or "engine," placed in the tank containing the solution of alkali.

The pulp obtained, as above described, having been freed from the alkali by washing, (which may be saved as before directed,) may now be bleached by the usual process, or, as we prefer, by chlorite or hypochlorite of soda or potash, liberating the chlorous or hypochlorous acid by hydrocholoric acid.

In the above processes we do not confine ourselves to the particular apparatus or utensils herein named, but claim the use of chemical processes and in order herein stated.

In witness whereof, I the said Charles Watt, have hereunto
429 set my hand and seal this twenty-third day of January, in the year of our Lord one thousand eight hundred and fifty-four.

[L. S.] CHARLES WATT.

Witness: B. GOBEY, Old Square, Lincoln's Inn.

Exhibit XXXV.—No· 467.—Paper.

Letters patent to Frederick Burnet Houghton, of Upper Gloucester Place, Dorset Square, in the county of Middlesex, for the invention of improvements in the preparation of materials used in the manufacture of paper. Sealed the fourth day of August, 1857, and dated the seventeenth day of February, 1857.

Provisional specification left by the said Frederick B. Houghton, at the office of the Commissioner of Patents, with his petition, on the 17th February, 1857.

I, Frederick Burnett Houghton, of Upper Gloucester Place, Dorset Square, in the county of Middlesex, do hereby declare the nature of the invention for improvements in the preparation of materials used in the manufacture of paper to be as follows:

This invention has for its object improvements in the preparation of materials to be used in the manufacture of paper. It has before been proposed to reduce the fibres of wood and the woody fibres of vegetable matters, by the aid of heated alkaline solutions in closed vessels under pressure, into a condition suitable for making pulp. Now, I have, after numerous experiments, ascertained that for practical purposes it is necessary to carry the process on under a far higher degree of heat and pressure than have hitherto been resorted to, and that the alkaline solution employed must at the same time be greater than has heretofore been used.

In carrying out the present invention, it is preferred to use an alkaline solution of a strength equal to from 6½° to 7° or more of Beaume, and heated in a suitable boiler to such a temperature as to produce a pressure of from one hundred and eighty to one hundred and ninety pounds on the square inch; at the same time it should be stated that
less heat and pressure may be resorted to when using the
430 strength of the alkaline solution above-mentioned, but the same must be continued during a great length of time. The strength of the alkaline solution above-mentioned may also be reduced to the same extent, say to 4° Beaume, provided the heat and pressure be greater or continued for a greater length of time that is required when using a solution of 7° Beaume. Under no circumstances, however, is any claim made to a process where less heat and pressure than are equal to ninety pounds on the square inch are employed, whatever be the strength of the alkaline solution used. In constructing suitable boilers for these purposes it is preferred to heat the contents by means of tubes, in which hot water is circulated according to the system originally invented by Mr. A. M. Perkins, as by such means the process above explained may be carried on more safely and advantageously.

Specification, in pursuance of the conditions of the letters patent, filed by the said Frederick Burnett in the Great-Seal Patent Office, on the seventeenth day of August, 1857.

To all to whom these presents shall come, I, Frederick Burnett Houghton, of Upper Gloucester Place, Dorset Square, in the county of Middlessex, send greeting:

Whereas her most excellent Majesty, &c., &c., Queen Victoria, by her letters patent bearing date the seventeenth day of February, in the year of our Lord one thousand eight hundred and fifty-seven, in the twentieth year of her reign, did for her heirs and successors, give and grant unto me, the said Frederick Burnett Houghton, her special license, that I, the said Frederick Burnett Houghton, my executors, administrators, and assigns, or such others as I, the said Frederick Burnett Houghton, my executors, administrators, and assigns should at any time agree with and no others, from time to time and at all times hereafter, during the term therein expressed, should and lawfully might make, use, exercise, and vend within the United Kingdom of Great Britain and Ireland, the Channel Islands and Isle of Man, an invention for improvements in the preparation of materials used for the manufacture of paper, upon the condition (amongst others,) that I, the said Frederick Burnett Houghton, my executors, or administrators, by an instrument in writing under my or their, or one of their hands, and seals, should particularly describe and ascertain the nature of the said invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office, within six calendar months next, and immediately after the date of the said letters patent.

Now, know you, that I, the said Frederick Burnett Houghton, do hereby declare the nature of the said invention, and in what manner the same is to be particularly described and ascertained, in and by the following statement thereof; that is to say, this invention has for its object improvements in the preparation of materials to be used in the manufacture of paper. It has before been proposed to reduce the fibres of wood and the woody fibres of vegetable matters by the aid of heated alkaline solutions in closed vessels, under pressure into a condition suitable for making pulp. Now, I have, after numerous experiments, ascertained that, for practical purposes, it is necessary to carry the process on under a far higher degree of heat and pressure than have heretofore been resorted to, and that the alkaline solution employed must, at the same time, be greater than has heretofore been used. In carrying out the present invention, it is preferred to use an alkaline solution of a strength equal to from 6½° to 7° or more of Beaume, and heated in a suitable boiler to such a temperature as to produce a pressure of from 180 lbs. to 190 lbs. on the square inch; at the same time, it should be stated that less heat and pressure may be restored to, when using the strength of alkaline solutions above mentioned, but the same must be continued during a great length of time. The strength of the alkaline solution above-mentioned may also be reduced to some extent, say 4° to Baume, pro-

vided the heat and pressure be greater, or continued for a greater length of time than is required when using a solution of 7° Beaume. Under no circumstances, however, is any claim made to a new process where less heat and pressure than are to 90 lbs. on the square inch are employed, whatever be the strength of alkaline solution used.

In constructing suitable boilers for these purposes, it is preferred to heat the contents by means of tubes in which hot water is circulated according the system originally invented by Mr. A. M. Perkins, as by such means the process above explained may be carried on more safely and advantageously.

Having thus stated the nature of my said invention, I will proceed more fully to describe the manner of performing the same.

The form and arrangement of apparatus prepared for carrying out the invention are as follows: A strong, cylindrical boiler, with hemispherical ends, the upper end being formed in such a manner as to act as a moveable cover on which is a safety valve; at the lower end of the boiler, there is introduced coils of wrought-iron tubes suitably arranged to have highly heated water circulated therein, according to the system known as "Perkins' system of hot water circulation," by which the interior contents of the boiler can be more conveniently up to, and retained at a high degree of temperature requisite for carrying out my invention than by any other system of heating I am acquainted with.

The vegetable fibrous matter to be treated are introduced into the interior of the boiler by means of a cylindrical basket, or open metallic frame, surrounded on all sides with strong wire gauze. The vegetable fibrous materials to be treated are packed into such baskets in a succession of layers supported on a series of moveable partitions, or circular frames of wire gauze, which are retained in position within the cylinder by pins or bolts passed through the uprights of the frame of the cylinder, and the same is lowered into the boiler, the upper end of which is then closed. The boiler is then filled with the alkaline solution of the strength, such as is above mentioned, from a suitable cistern, and such solution may be introduced in a heated or cold state. The highly heated water caused to circulate in the coils of tubes within the boiler will quickly raise the temperature of the contents of the boiler. I find that a temperature varying from 376° to 380° on the square inch, and continued from ten to thirty minutes, according to the nature of the vegetable fibrous matter for the time being under process, and the best for general purposes. I would state that the time of the process varies according to the nature of the vegetable fibrous matters, and no more precise or exact rule can be given; but a workman will quickly become acquainted with the proper time for a particular description of vegetable fibrous matter, and it will only, under any case, be necessary from time to time to allow the apparatus and its contents to cool down, and to remove the cover, in order to ascertain whether the desired result has ben obtained, but this will seldom be necessary after some practice, and principally when, for the first time, acting on some vegetable fibrous substances not previously treated.

The strength of alkaline solution which I prefer is from 4° to 7° of Beaume, but I do not confine myself thereto, neither do I confine myself to the range of temperature above mentioned, as they may be varied, but I make no claim to any process whatever be the strength of the alkaline solution, if the temperature is not equal to produce 90 lbs. pressure on the square inch.

In witness whereof, I, the said Frederick Burnett Houghton, have hereunto set my hand and seal this eighth day of August, in the year of our Lord one thousand eight hundred and fifty-seven.

[L. S.] F. B. HOUGHTON.

Witness: GEO. PITT.

Exhibit XXXVI. Patent of A. S. Lyman. August 3, 1858. *No.* 21,077.

THE UNITED STATES OF AMERICA:

To all to whom these letters patent shall come:

Whereas Azel Storrs Lyman, of New York, N. Y., has alleged that he has invented a new and useful improvement in separating the fibre of wood, which he states has not been known or used before his application, has made oath that he is a citizen of the United States; that he does verily believe that he is the original and first inventor or discoverer of the said improvement, and that that same hath not, to the best of his knowledge and belief, been previously known or used; has paid into the Treasury of the United States the sum of thirty dollars, and presented a petition to the Commissioner of Patents, signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose:

These are, therefore, to grant, according to law, to the said Azel Storrs Lyman, his heirs, administrators, or assigns, for the term of fourteen years from the third day of August, one thousand eight hundred and fifty-eight, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said improvement, a description whereof is given in the words of the said Azel Storrs Lyman in the schedule hereunto annexed, and is made part of these presents. In the testimony whereof, I have caused these letters to be made patent, and the seal of the patent office has been hereunto affixed.

Given under my hand, at the city of Washington, this third day of August, in the year of our Lord one thousand eight hundred and fifty-eight, and of the independence of the United States of America the eighty-third.

[L. S.] (Signed) JACOB THOMPSON,
Secretary of the Interior.

Countersigned and sealed with the seal of the Patent Office.

(Signed,) J. HOLT,
Commissioner of Patents.

The schedule referred to in these letters patent, and making part of the same. Specification.

To all whom it may concern:

Be it known that I, Azel Storrs Lyman, of the city, county, and State of New York, have invented a new and improved mode of effecting the separation of the fibres of wood for the manufacture of paper, and of flax and other fibrous substances, for the manufacture of cloth, and for other purposes; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings and to the letters of reference marked thereon:

It is well known that the fibres of most kinds of wood are arranged in the form of very minute tubes in which the sap circulates. My improved method of separating these fibres consists in placing the wood or other fibrous material in a strong cylinder, or box, in which it is subjected to the action of hot war, steam, compressed air or other fluid, under pressure, for the purpose of charging its tubes and then causing it to be suddenly projected from the said cylinder or receptacle into the atmosphere, or into partial vacuum, where each of the tubes is, by the expansive force acting within it, burst open, and the whole of the mass converted into fibre.

431

The accompanying drawing, which forms part of this specification, exhibits a longitudinal central section of a cylinder, or as from its operation it may be termed, a gun, for effecting the separation of the fibres. This gun may be of any suitable length and calibre, but I consider, for practical purposes, it will be convenient to have it about seven inches diameter, internally, and from twenty to twenty-five feet long, as it may then be made by taking a piece or pieces of lap-welded iron tubing, and permanently closing one end. The other end is fitted with a moveable head or cap B, which is fitted to it after the fashion of a valve, with a suitable packing for making a steam-tight joint. And in order to provide for securing this cap valve B firmly in its place to close the gun, I attach to one side of the gun, by a rigid arm and hinge-joint D, a strong lever C, which is capable of being brought to a position across the cap B, and secured in that position by a hook E, at one end of the lever H, which is attached to the gun on its opposite side by the hinge-joint *i*. The other end of the lever, E, has hinged to it a prop-piece K, which is employed to rest upon the side of the gun for the purpose of securing the hook E, upon the lever C. S is a screw working in the lever C, for the purpose of securing the cap closely to the mouth or muzzle of the gun, and *m* is one of the screw-bolts which attach the cap loosely to the lever E. Several of these bolts, fastened firmly in the valve B, and sliding in the lever C, are used for the purpose of retaining the cap B, at the time of the explosion. This gun is to be placed in a slightly inclined position, so that a small quantity of water shall settle near the breech-end. It should be mounted in a very strong frame to sustain it against recoil. I prefer to have the wood or other fibrous sub-

stance saturated with water before it is put into the gun. When put in, the lever C, it is brought up and secured by bringing down the hook E, of the lever H, upon it, and setting up the prop-piece K; then the strong screw S, is driven in to close the cap B, tightly. Next we expel the air by opening a small valve, not shown, and letting in the steam by another small tube, not shown, but near the opposite end of the gun from the air-escape valve. When the air is expelled, close the air valve, and open the valve in another small tube connecting the boiler and gun so that the water that condenses in the gun may run back down into the boiler. If large sticks of wood are in the gun the steam must be admitted for some minutes to heat them through. If hemp, flax, or straw is to be separated, less time is required in the steam. I have found a pressure of one hundred and eighty pounds per inch is about right for separating pine for paper, but a much less pressure will answer for flax or straw.

When the heat has sufficiently penetrated the fibrous substance to be exploded, the cap B, may be set free, which is done by removing the prop-piece K, when, if the angle of the hook E, is properly made, the pressure of the steam in the cylinder gun will raise the end E of the lever H, and drive off the cap B, and free that end of the gun. The small quantity of the hot water at the breech of the gun now drives out the contents of the gun into the atmosphere; as it emerges from the gun, being freed from outside pressure, the sudden conversion of a portion of the water in its tubes or fibres into steam of high tension, bursts and separates these fibres. It is evident that the apparatus employed in the performance of my invention, and the mode of performing it, may be modified considerably without departing from the principle theory; for instance, instead of using a separate boiler to supply steam to the gun, the steam may be gen-
432 erated and the water heated in the gun itself, by placing therein a quantity of water and applying the necessary heat to the exterior of the gun. Again, before subjecting the fibrous substance to the action of water or steam, the air may be extracted from it by means of an air-pump. It is also evident that instead of water, alchohol, or other liquid, or any elastic gas may be used. The invention may also be applicable to the separation of the fibres of other than vegetable substances and for a variety of purposes.

Claim.—What I claim as new and desire to secure by letters patent is the mode of separating the fibres of wood, flax, or other fibrous substances for paper, for paper-cloth, or other purposes, by charging the mass with hot water, steam, compressed air, or other elastic fluid, while in a cylinder or other suitable receptacle, and then causing it to be projected from said receptacle into the atmosphere, or any space where it is subjected to a sufficiently less pressure to cause its disruption by the sudden expansion of the fluid within it, substantially as above specified.

(Signed) AZEL STORRS LYMAN.

Witnesses:
EDWIN F. BROWN.
G. Y. ATLEE.

Exhibit XXXVII.

REGNAULT'S CHEMISTRY.—ESSENTIAL IMMEDIATE PRINCIPLES OF PLANTS.

[Translated by Booth and Faber. Philadelphia, 1852.]

§ 1274. A microscopic examination of the various component parts of plants shows them all to be constituted of cellular tissue varying in form according to the part of the vegetable subjected to inspection. The cavities of the tissue are filled with very diversified matter; sometimes, as in the case of wood, the parietes of the cells are covered by a hard and brittle substance, called lignine or woody fibre, which frequently almost fills their interstices; while, at other times, as in the grains of the cerealia, potatoes, and other tubers, the cells contain a quantity of small ovoidal globules,
433 varying in size, constituting fecula or starch; and lastly, in the case of the young organs of plants, the cells contain only a more or less viscous fluid, holding in solution mineral salts and various organic substances, the principal of which are gums, gelatinous substances, and certain nitrogenous combinations, designated by the general name of albuminous substances. Oils or fat substances are frequently found in the cells, as in the oleaginous grains, sometimes in large quantities.

We shall begin by the study of these various substances, which are found in all members of the vegetable world, and which are essential to the existence of plants.

Cellular tissue or cellulose, $C_{12}H_{10}O_{10}$.

§ 1275. The cellular tissue is particularly evident in the young organs of vegetables. The cell is formed in the liquids which circulate through the plant, and grows by successive agglutination with the cells previously formed, which occasions a modification in the original forms of the cells. Sometimes they are rounded, and show a certain regularity, as in the pith of the elder, (fig. 649,) and in the potato, in which case they constitute the cellular tissue properly so called.

At other times the cells form elongated tubuli, communicating by their contracted extremities, as seen in fig. 650, which represents the longitudinal section of a stalk of asparagus, of which a transverse section is seen in fig. 651, and in figs. 652 and 653, which exhibit (fig. 653) a fibre of flax or hemp, and (fig. 652) a fibre of cotton; the tissue is then called a vascular tissue.

As the vegetable portions grow old on the living plant the vascular vessels are filled with wooden fibre, which increases gradually in thickness, and leaves only very narrow canals for the circulation of the sap. The whole of this mechanism constitutes wood. Among all the substances entering into the composition of plants, the cellular tissue is distinguished by its great resistance to chemical agents—a resistance which allows its separation in a state of purity sufficiently perfect to permit the study of its chemical properties, and to ascertain its elementary composition. It has thus been found

to be identical, in this respect, not only in all parts of the same plants, but also in all different vegetables. Chemists have given the name of cellulose to that constant substance which they regard as forming the cellular tissue of all plants.

Cellulose is nearly pure in cotton, in which case it consists
434 of the down of the cotton seed, and in hemp and flax, that is in the textile fibres extracted from the plants of these names. Cellulose is also nearly pure in paper and old linen, which are made of the substances just mentioned, and which, during their preparation and use, have been subjected to various chemical reactions, which have gradually effected the entire destruction of the more changeable foreign substances, mixed with the cellular tissue properly so called.

Cellulose is extracted from various parts of plants by subjecting them to successive chemical reactions which destroy the more alterable woody fibre, the preparation being longer and more difficult in proportion to the quantity of woody fibre. The substance, when obtained in as disaggregated a form as possible, is digested with hot solutions of caustic potassa or soda, and, after washing, the residue is treated with weak chlorohydric acid, and washed with water. By a repetition of this process for a certain number of times, the woody fibre may be completely removed, although the same result may be obtained more quickly by subjecting the substance to more powerful oxidizing re-agents, such as a weak solution of chlorine or hypochlorite of lime, and following each of these treatments with an alkaline solution and dilute chlorohydric acid. Although these various re-agents attack the cellular tissue itself, the action on it is much less active than on the substances surrounding it; so that if the operation be carefully conducted, and re-agents diluted with water be alone used, the greater portion of the cellulose escapes destruction. It is washed successively with alcohol and ether to dissolve the fatty matter.

Pure cellulose, which is white and transparent, is insoluble in water, alcohol, ether, and the fixed or volatile oils. Dilute acid solutions have but little effect upon it, even at the boiling point, which is also true of sufficiently diluted alkaline solutions. The resistance which cellulose presents to these re-agents varies with its cohesion; recently formed cellulose being much more easily changed than that of older date.

435 *Exhibit XXXVIII.*

MANUFACTURE OF PAPER.—DR. L. MULLER.

[True edition. Berlin, 1855, page 32.]

The increase of the temperature of steam with the higher pressure is shown in the following table:

Pressure of steam in atmosphere.	Temperature, Reaumer's scale.
1	80°
1½	90°
2	98°
2½	104°
3	109°
3½	113°
4	117°
4½	121°
5	124°

A representation of a boiling apparatus, which saves a great deal of steam and is very easy to be emptied, is shown in fig. 11:

A is a boiler of elliptical form, made of two parts of cast iron screwed or bolted together, the height of which is from 7 to 8 feet, and the largest diameter 4½ to 5 feet.

The thickness of the sides is seven-eigths of an inch. It is closed above and below by means of cast iron plates that can be opened, the first of which plates is furnished with a safety valve, and by means of a cord and pulley is raised, and when closed can be fastened through the hooks b, which catch in ears screwed upon the upper edge of the vessel.

The lower plate is fastened to the kettle or boiler by means of a hinge upon which it turns. By means of a pulley and cord the raising and lowering of this plate is very easily accomplished. The cord is fastened by means of the hook or clasp d, which is fast in the plate.

Finally, there is an opening in the middle of this plate, which opening is protracted by means of the pipe e, fitted with a cock.

The apparatus is furnished with a system of pipes which carry the steam from the steam generator to the drying cylinder of the machine.

The position of this machine, whether high or low, whether in the open air or the interior of the building, depends entirely upon circumstances. Certainly the filling will be accomplished with much greater ease if it stands immediately under or next to the lower floor, upon which the rags, cut up and ready for boiling, are placed, and where also are placed cisterns for solutions of lime or soda; f is the main feed pipe which carries the steam directly to the machine, and must be carried higher than the greatest height of the liquid in the interior of the apparatus, so that the fluid for boiling may not fall back into it, and thence go to the steam reservoir.

So soon as the apparatus is filled with rags and the proper liquid

the upper cover is made fast, and, by shutting the cock g, the steam is made to pass through the pipe h, which is made to enter the boiler just over the lower floor or end.

436 This pipe expands into the perforated copper pipe i, which runs around the lower part of the boiler. The steam rushing out from these openings penetrates the rags and mingles with the fluid that has been poured upon them for boiling.

The steam which collects above the liquid passes out through an opening close under the upper cover into the ascending and descending pipe k, in which, by a sieve or grating at l, any substances passing up are stopped.

The pipe k leads finally the steam again into the feed pipe f, and from there to the drying cylinders of the machine.

Such an apparatus of the dimensions given is fitted to contain from 9 to 10 cwt. of rags. The steam must first have a pressure of about 1 1-2 atmospheres to overcome the pressure of the rags and the fluid, and it is necessary to leave the cock g partly open, so that the drying cylinders of the machine may not become cooled.

Exhibit XXXIX. Paper Manufacturer's Journal. Paris, 1858.

[Vol. 5, page 34, figures 29 and 30.]

CHAPTER II.—OF DIGESTING OR TREATING THE RAGS WITH LYE.

§ 2. Different processes of cleansing.—The apparatus represented in figures 29 and 30 is composed of a boiler of sheet (or plate) metal, 5 metres and 50 centimetres in length by 1 metre and 55 centimetres in diameter, the plate of metal being 12 millimetres in thickness, and the boiler containing 1,200 to 1,500 kilograms of materials. Constructed after the manner of steam boilers, it has at its upper part a man hole B, through which the rags and the lye are introduced. A safety valve C, of 6 centimetres opening, is weighted directly with 116 kilograms, or with a lever of 42 centimetres, at the end of which is suspended 19 kilograms, to counterbalance the pressure of 4 atmospheres under which it is necessary to keep the steam pressure.

The bottom of the boiler is furnished with a movable screen D, of cast iron pierced with holes for holding the rags, and formed of several pieces resting upon the curved sides of the boiler and in the center upon a cast iron bar, arranged so that it may be raised or removed for cleaning it. E is a cast iron plug placed freely

437 upon a hole of the same diameter made in the bottom of the boiler.

The withdrawal tube F has, at G, a circular groove, in which is fitted a ring of galvanized (vulcanized) rubber against which rests the hinged cover H, which communicates by a chain with the balance weight I, weighted to sustain the cover when it is open. K is a pulley upon which runs the chain of the balance weight.

The boiler is placed over an ordinary furnace and is warmed by the fire direct; the flame after having circulated by means of the

vent holes around the boiler, goes into the chimney L, which is raised to the height of 20 metres or thereabouts, to increase the draught.

The boiler having been filled three-quarters full, the cover of the manhole is closed, and the fire is lighted. At the end of about an hour, a pressure of from 3 to 3½ atmospheres is reached, and it is not necessary to go beyond this. The fire is then allowed to subside, and after the time necessary for the digestion, varying according to the nature of the materials, the fire is withdrawn, the steam is let off through the pipe M, fig. 29, into another boiler or vat containing waste paper or rags that only need a slight cleansing or washing.

When the steam is out a lever of iron is passed into the furnace, and the plug E is pushed out and falls on the bottom of the boiler.

The opening then gives passage to the liquid, which is replaced by water that cleanses out all foreign matter, commences the washing of the rags and cools them.

The rags are removed through the pipe F after the cover H is raised over a vat placed underneath.

Exhibit XL.

The manufacture of Paper, by Louis Pielte, 1861, vol. i., p. 21, figs. 7 and 8.

* * * * *

438 Figs. 7 and 8 represent a cylindrical boiler A made of iron plates, five lines in thickness, seventeen feet long, and five feet high. An opening B is made in the top through which the rags and the lye are put in, and it is furnished with a safety-valve C, of two inches four lines in diameter. This safety-valve is loaded directly with two hundred and fifty pounds, or it is covered by a lever sixteen inches long upon which thirty-eight pounds are hung, arranged so as to sustain a pressure of four (4) atmospheres. At the lower part, a few inches from the bottom, is a cast-iron grating upon which the material rests and which prevents it from touching the bottom of the boiler.

This grate, a sort of hurdle, (or like a hurdle,) consists of several pieces, which rest upon the curved sides of the boiler, and in the middle upon an iron foot, so that the several pieces of grating can be removed for cleaning the vessel each time it is used.

E is an iron plug that rests freely upon a hole pierced through the bottom of the boiler. The waste pipe F, for emptying, contains at G a circular groove or rabbet, in which is placed a ring of galvanized rubber, (vulcanized.) Against this ring the cover H is screwed. The cover is furnished with a hinge and is connected through an iron roller with a balance weight I, that holds it up during the process of emptying the boiler. K is a roller upon which the chain of the balance weight runs.

The boiler enclosed in the walls of a common furnace is heated directly, and the flame after passing around the boiler goes off into the chimney L. which is raised to the height of sixty feet to increase the draft.

The kettle is now filled rather more than half full with the material to be cleansed and the lye, and the upper cover is screwed down, the fire built and after about an hour a temperature of from three to three and a half atmospheres is reached, beyond which it must not be raised.

The fire is then diminished and after the time necessary for treating with lye, the remnants of the fire are withdrawn and the steam is conducted through the pipe R into another boiler or into a tub in which waste paper or rags are placed that do not require so forcible a treatment. After the steam has passed off an iron lever is placed in the furnace, underneath the boiler and by a strong pressure under the plug E it is raised up and falls over in the boiler. The opening gives free passage to the fluid which is replaced by fresh wa-
439 ter, that carries out with it all foreign substances and cools the rags. The material (rags) is through the pipe F, after the cover H is opened, cast into a receptacle placed underneath.

Fig, 8 represents an apparatus that differs from the preceding in that it is heated by steam that passes through it instead of being heated by the direct application of fire.

The elliptical iron plate boiler A, consists of two parts which are screwed the one upon the other. It is about nine feet high and measures five feet at its largest diameter. The upper and lower parts are closed with plate iron covers. The first one, furnished with a safety-valve, is through a roller C, and a chain fastened on the ears E E, raised or lowered. The hinge G regulates the movements of the lower plate F, which is raised or lowered by means of a chain H and a roller I. In an opening in the iron plate is screwed the cock K.

After the boiler is filled, not over three-quarters full, with the material and the lye, the upper cover is lowered and hermetically sealed, and then the steam introduced from a boiler close by.

The steam passes from L into the pipe N, provided with small openings, (perforated.)

The steam penetrates the material, causes it to boil and after it has reached the surface passes into the pipe O which carries it back again to L, from whence it passes into another similar kettle for boiling in lye or goes into the drying cylinders of the paper machine, or indeed by closing the cocks R and S goes back again into the kettle A. O contains at P a metallic sieve that keeps back the particles of material that are carried up with the steam.

When the boiling is finished the lye passes out through the open cock K and the material falls, after the under plate F is lowered into a cask placed under the boiler.

The apparatus constructed in the above named proportions of plate iron five lines in thickness contains twelve hundred pounds material, and the operation can, under a pressure of about four atmospheres, be repeated daily in the same boiler three or four times.

440 *Exhibit XLI.*

Julius A Jillson and Henry Whinfield, of Poughkeepsie, New York. United States Letters-patent, No. 13,650, dated October 9, 1855.

To all whom it may concern :

Be it known that we, Julius A. Jillson, of the city of Poughkeepsie, county of Dutchess and State of New York, and Henry Whinfield, of the city, county, and said State, have invented new and useful improvements in washing articles of wearing apparel and the various textile and fibrous substances and materials; and we do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the annexed drawings making a part of this specification representing the machine in which—

Figure 1 is an elevated perspective view; figure 2 is a vertical sectional view. The same letters have reference to the same parts in each view.

A is a cylinder; B is the air tight cover; C is a set screw in a movable arch, confining the cover B; D is a strainer fixed or movable, made of metal, cloth, or paper, or their equivalent, resting on a rib or bracket in the cylinder A. E is a movable inside cylinder, with strainer F, made similar to strainer D. G is a furnace under cylinder, either for heating air or liquids; H is a cock to run off the liquids or refuse; I is a double or single acting force pump with valves, piston, and piston rod, to be driven by hand or power; J and K are cocks in said pump for air or liquid; L is valve and chamber at bottom of pump; M is valve and chamber at top of pump; N pipe connecting bottom of cylinder A, with the lower valve L, of pump; O is pipe connecting with cylinder A and valve L; P is pipe connecting top of pump with top of cylinder A, and passing through the valve M; Q R and S are three stop cocks for changing the working of the machine herein described. T is a small chamber connected with pump I, and cylinder A, by the pipe X; U is a cover to small chamber T; V is a set screw confining the cover *U*, air tight; W is a glass cup or dish in said chamber T; Y is a stop cock in pipe X; Z is a movable cover used in the inner cylinder E, or in the cylinder A, perforated similar to strainers D or F, for the purpose of keep-

441 ing the wearing apparel, &c., &c; substances or other materials in said cylinders E and A level and of an uniform height; and, also making a uniform distribution on the surface of the contents of said cylinders A and E; a, a is a pipe passing through and around furnace G, and connected with the top of cylinder A, at b, b, with a shut cock c, c, when not used.

To enable others skilled in the art to make or use our invention, we will proceed to describe its construction and operation.

We construct the said machine of any suitable materials, such as brass, copper, zinc, tin, iron galvanized, or wood, or their equivalents, of any given size or shape, suitable or equivalent to perform and operate on the various textile and fibrous fabrics or substances.

The method of washing or cleansing the said wearing apparel, and

the various textile and fibrous fabrics, or substances or dirt and gum from animal or vegetable wools, silks, rags, and all other materials and substances of a similar nature, is by placing any of the last-named articles, materials, or fabrics in the cylinder A or E, and having also placed a sufficient or desired quantity of cleansing liquid in the cylinder A, made of soap or any other composition or equivalent, either hot or cold, as the case may require, and the pump being set in motion, our said method commences either in the ordinary way or by force, or in a vacuum or partial vacuum, either by heat or otherwise, made in said machine, or similar or equivalent, by opening the stop-cocks R and J and closing the stopcocks K, P, Y, and S, a vacuum or partial vacuum will be obtained; and having all the stop-cocks closed except S and Q, which are open, and a sufficient or desired quantity of cleansing liquid having been placed in the said cylinder A, with the said articles, materials, or fabrics, &c., before named, and working the pump as before described, the cleansing liquid is forced and rotated through and through the said wearing apparel, and the various textile and fibrous fabrics or substances, or animal or vegetable wools, silks, rags, and all other materials of a similar nature, without rubbing or injuring the same, until in a short time every particle of dirt or gum, &c., is removed and taken out, and refuse or dirty liquid discharged by the cock H, or retained in any suitable place for colored clothes, &c. Then by opening the cock K, which is, or can be, connected with either hot or cold water, a stream of clean water can be introdnced for rinsing purposes, and rotated through and through, and continued and changed until in a few minutes the contents of the said cylinders will be entirely cleansed and rinsed without removing, twisting, or injuring the said contents of said cylinders.

By the machine, the articles, after being washed and rinsed, can be dried under its operation, in this way : By closing the stop-cocks S, Y, and Q, and removing the cover B of the cylinder A; when cold air is used, and rotating the pump, a stream of air is drawn through the contents of said cylinders A and E and discharged at J; or, with hot air when required, by closing the said stop-cocks S, Y, K, and Q, and opening the stop-cock C, which admits hot or heated air through the pipe *aa*, from the furnace G, by the pipe *b*, into the top of the cylinder A, with the cover air-tight and the stop-cock J open; then rotating the pump a current or stream of heated air will be forced continuously through and through the said contents of said cylinders, until in a very short time they will be dried sufficiently for ironing.

There is attached to this machine, as shown by letter T, a
442 small chamber or vessel with pipes connecting to said machine for the purpose of generating and passing into the washing chamber or cylinders A and E, bleaching or disinfecting gasses or liquid, by closing the stop-cocks J, R, and S, will escape from the said chamber T by the pipe X; then open the stop-cocks R, Y, and P, rotate the pump, and the said bleaching or disinfecting gasses or liquids are forced through and through, over and over in a vacuum

or partial vacuum, or in the ordinary way, until in a very short time the contents of the said cylinders A and E will be perfectly bleached or disinfected, and then by closing the stop-cocks J, K, P, and S, the said bleaching or disinfecting gasses or liquids can be nearly all forced back into the small chamber T, and retained in the same by closing the stop-cock Y until wanted again. The cylinder A can be opened and contents removed.

In fact the washing or cleansing, rinsing, bleaching, and drying can be completed without taking any of the aforesaid articles, materials, or substances out by a machine constructed according to this description, substantially.

Claim.—Having now described and fully set forth our invention, what we claim as new, and desire to have secured to us by letters patent, is combining with the washing, extracting, or receiving chamber, the double acting force pump, and the disinfecting or bleaching vessel operating substantially, as, and for the purposes herein set forth.

J. A. GILSON,
HENRY WHINFIELD.

Witnesses:
SILAS E. HAIGHT,
ABM. FONDA,
Witness as to J. A. Gillson.
SILAS E. HAIGHT,
J. H. GADDARD,
Witness as to H Whinfield.

Exhibit XLII.

10,898.—French patent for fifteen years, from August 7, 1854, to M. Ladet, of Paris, for a process applicable to the manufacture of paper.

This process consists in the production of a pulp, either white or of a color fit for the manufacture of paper, from straw or other fibrous vegetable matters, by the combination of the following modes :

First. The employment of a caustic alkaline solution, or a solution of hydrate of soda or potash, of 3° or 4° Beaume.

Second. Acting on the materials with the above liquors by a systematic process of sprinkling.

443 Third. Digesting the materials under a pressure of five or six atmospheres.

Fourth. Bleaching the material in a close vessel, as will be explained further on.

After having cut the straw in lengths of one or two centimetres, and having winnowed it to remove the knots, grains, pieces of twigs, and large weeds, and having washed it in tepid water, place it in a boiler, the dimensions of which is a matter of indifference, but which should be so constructed as to stand a pressure of six atmospheres. The boiler placed horizontally rests by trunnions fixed on its two extremities on journals. By means of the trunnions it can receive,

by some ordinary method, a slow rotation. These trunnions are hollow, and by means of stuffing boxes the one is connected with a steam gauge, the other with a pipe. The alkaline liquors, steam, or washing water, are introduced into the boiler by means of suitable cocks. On one of the trunnions is screwed in the interior of the boiler an arrangement of pipes of three or four branches, closed at their ends and resting on the side of the boiler; or there can be riveted a coil, closed at its end, the size and length of the boiler. In either case it is as well to place pieces of pipe, of same diameter as main pipe, ten or twelve centimetres distance, and ten centimetres in length, which terminate in as small a point as possible, and which should be pierced with divergent holes about five millimetres in diameter.

The main branches of pipe or the spiral should also be bored with holes of the same size, taking care to make them divergent and as close as possible.

This system of pipes is connected, as I have said, with an external main pipe, by means of a stuffing box, from which branch three other pipes, each supplied with a cock, one communicating with a boiler, the second with a reservoir from which the alkaline liquors are conveyed into the boiler, as I have just explained, the third with a reservoir of cold water.

The reservoir from which the alkaline solutions are to be conveyed into the boiler may be arranged in one of the following modes:

First. An open vessel placed at a sufficient height above the boiler, so that the said liquors, in consequence of the difference in the level, squirt with a certain force through the holes of the arrangement of pipes above mentioned.

444 Second. The same open vessel placed in the most convenient situation, but provided with a force pump for driving the liquors into the boiler.

Third. A closed vessel from which the liquors may be forced by the pressure of the steam taken from the neighboring boiler, through a pipe dipping to a few centimetres from bottom of said vessel, and connecting with the main pipe, attached to trunnions.

Any of these modes may be adopted, but it is important that the mas of material should be uniformly, and, so to speak, instantaneously penetrated throughout. When the material to be treated is charged in the boiler by the man holes turned downwards, (these being closed) and the boiler started, introduce a quantity of alkaline liquor of the strength stated in the proportion of three hundred or three hundred and fifty litres for the one hundred kilos of the quantity of the material to be treated.

When the necessary quantity has been introdueed in this manner, the same liquors may, if thought advisable, be left in the reservoir. This may be effected by placing at the end of the boiler, where the safety-valve is, a partition of wire cloth, and between this partition and the end of the boiler, a scoop weeel, which raises the liquor filtering through the metallic wire and returns it to the reservoir by a pipe fixed in the trunnion, but this may be dispensed with. When the liquor treatment is finished straw may be introduced into the

boiler and maintained for six or eight hours at a pressure of six atmospheres, care must be taken that the pressure should be kept as near as possiple between fixe and six atmospheres.

At the termination of the time before mentioned close the steam pipe, and continue to revolve the boiler until the pressure falls to one or one-half an atmosphere, then introduce, by means of a force pump or by difference of level, a sufficient quantity of cold water, and when the whole is sufficiently cooled, open the man-heads and discharge the materials.

The division of the wire cloth and the scoop wheel, of which I have spoken above, may be worked advantageously when the pressure is reduced below half an atmosphere for the purpose of washing with boiling water. To effect this open a cock in connection with the water in the boiler, while at the same time fresh water is being introduced by one of the above-mentioned modes. In any case the material under treatment, after being boiled, must be washed
445 until the water runs clear. Then treat in an acid bath of sulphuric or hydrochloric acid of one or one-half degree Beaume.

Again wash until the water is free from acid, and bleach in a solution of hypochlorite of lime of one and a half degrees Beaume.

Although the bleaching can be effected in the ordinary rag engines, or in pulp vats, where it is agitated by manual labor or mechanical power, I prefer the following mode:

When the material under treatment has been sufficiently drained, place it in an apparatus perfectly similar to that to which it has been boiled, but in place of its being iron it is made of wood. In regard to the pipes, they should be of lead or zinc, or even iron, but in this case they should be pointed with zinc white.

The apparatus being charged with the materials and started introduce, by means of a pump of difference of level, the quantity of solution of hypochlorite, of strength indicated, necessary to well steep the mass, which may be 650 or 700 litres per 100 kilograms of the matarial. By slowly turning the apparatus for some hours the bleaching is complete, and the pulp may be placed in the beating engines.

Addition, Aug. 7, 1855.

Recent experiments have proved that the steam should not be introduced into the boiler directly, but should be passed through a coil or a pipe fixed in the most suitable manner for heating the material in the boiler, and to bring to the desired pressure by means of contact alone; the water of condensation being returned again.

The steam can also be passed between plain concentric cylinders, one exterior the other interior, enclosing the matters to be heated, the water of condensation to be returned again.

By this new mode the liquors may be introduced before the manholes are closed, and then the strength may be reduced to 2½ or 3 degrees, the quantity being brought to about 600 litres to the 100 kilograms.

The cooling of the material may be effected by the same manner, a current of cold water being sent through the coil or pipe between the two cylinders, which steam just traverses and escapes as steam at the other end. In this case the washing must be done in a separate receptacle, but the quantity of hot water produced by the cooling of the boiler, with the condensed water produced
446 during the boiling, is abundantly sufficient. Five or six hours, the length of time during which the pressure is sustained, may be reduced to two hours or even one, according to the quality of the straw, and other stock to be operated on. The quantity of acid may also be reduced to 2½ per cent. of the weight of stock.

I have found great advantage in allowing the materials to remain several days after they have been cooked, previous to the washing. It is sufficient to allow the alkaline liquors to drain off. If, after this delay, the material is washed carefully with hot water, and with the acidulated solution, as I have described, a pulp will be obtained more homogeneous, flexible and susceptible of a better color.

Exhibit XLIII. Elements of the art of dyeing and bleaching.

BY C. L. AND A. B. BERTHOLLET, LONDON, 1841, P. 120.

The filaments of flax and hemp are enveloped in coloring particles, retained in them by a true combination, and which mask their whiteness. When these coloring particles combine with oxygen they are decomposed, so as to become soluble in alkalies. Hence the potash of the lye dissolves and separates them from the filaments. On repeating several times the exposure on the grass, or the immersion in chlorine, and the action of the lyes, we separate all the coloring particles of the filaments which remain white. By these operations the yarn loses nearly one-third of its weight.

If an acid be poured on the solution of the coloring particles in potash, and if we try the precipitate formed, which remains upon a filter, it is blackish and has the appearance of a body which has suffered a slight combustion, or has been carbonized. The lye, when saturated with the coloring particles, loses all its activity. What is here said of potash is equally applicable to soda.

Yarn bleached by the ordinary process, or by that just described, has lost a portion of its strength, whence it no longer can sustain the same weight as before bleaching; but if both operations be made with equal care, the yarn bleached by means of chlorine preserves more strength than that which has been treated by long exposure on the grass, because the lyes have been less numerous and the operations not nearly so long.

447 This mode of bleaching, then, is produced by the successive action of lyes and chlorine. We must therefore describe the apparatus and operations which the chlorine solution and the lyes require, as well as the means of promoting their action, preventing their inconvenience, improving their whiteness, or giving to bleached objects the qualities that are desired.

Exhibit XLIV.—English Patent, 1854.—*No.* 2172.

MANUFACTURE OF PAPER.

(This invention received Provisional protection but notice to proceed with the application for letters patent was not given within the time prescribed by the act.)

Provisional Specification, left by Marie Amedee Charles Mellier, at the office of the Commissioner of Patents, with his petition, on the 10th Oct., 1854.

I, Marie Amedee Charles Mellier, of Paris, do hereby declare the nature of the invention of improvements in the manufacture of paper to be as follows:

This invention consists in preparing pulp for the manufacture of paper in the following manner: I take straw or other vegetable fibrous materials and cut them into short lengths, wash them well, and soak them in warm water, I then place them into a suitable close vessel, where they are retained between two plates of perforated metal and boiled under a pressure of at least fifty-six pounds per square inch, by means of steam passing through a worm, or by other suitable means, with a solution of caustic potash or soda, of about from one to three degrees Beaume, they are afterwards well washed with hot water, and then cooled by admitting cold water to the vessel, and when bleached with hypochlorite of lime, or otherwise, are fit to be manufactured into pulp and paper in the ordinary manner.

448 *Exhibit XLV.—English patents, A. D.* 1855.—*No.* 988.—*Manufacture of paper.*

Letters patent to Marie Amedee Charles Mellier, of 47 Rue de Seine, St. Germain, Paris, for the invention of "An improvement in the manufacture of paper." Sealed the 26th October 1855, and dated the 2d May, 1855.—Provisional specification left by the said Marie Amedee Charles Mellier at the office of the Commissioner of Patents, with his petition, on the 2d May, 1855.

I, Marie Amedee Charles Mellier, of 47 Rue de Seine, St. Germain, Paris, do hereby declare the nature of the invention for "An improvement in the manufacture of paper" to be as follows:

This invention has for its object a peculiar process for the treating of straw, and other vegetable fibres requiring like treatment, preparatory to the use of such fibres in the manufacture of paper, and the improvement consists in subjecting straw, or such other fibrous material, to a pressure of at least seventy pounds on the square inch when boiling such fibrous matters in a solution of caustic alkali. For this purpose the straw or fibrous substances are then placed in a suitable boiler; and I use for such purpose a rotary boiler, provided with a coil or coils of steam-pipe, for the purpose of heating the contents; and I prefer that the boiling should be carried on at a temparature to

produce at or above eighty pounds on the square inch in the boiler, but so high a temperature is not absolutely necessary; but I have found by experiment that it is essential that a temperature equivalent to seventy pounds on the square inch must be employed. The quantity of alkali used is at the rate of about sixteen per cent. of caustic soda or potash of the straw or fibrous substances under process. The fibrous material may then be bleached by the use of a comparatively small quantity of chloride of lime.

Specification in pursuance of the conditions of the letters patent filed by the said Marie Amedee Charles Mellier, in the Great Seal Patent Office, on the 30th October, 1855.

To all whom these presents shall come, I, Marie Amedee Charles Mellier, of 47 Rue de Seine, St. Germain, Paris, send greeting:

Whereas her most excellent majesty Queen Victoria by her letters patent bearing date 2d day of May, in the year of our Lord one thousand eight hundred and fifty-two, in the eighteenth year of her reign, did for herself, her heirs, and successors, give and grant unto me, the said Marie Amede Charles Mellier, her special license, that I, the said Marie Amede Charles Mellier, my executors, administrators, and assigns, or such others as I, the said Marie Amede Charles Mellier, my executors, administrators, and assigns, should at any time agree with, and no others, from time to time, and at all times thereafter during the term therein expressed, should and lawfully might make, use, exercise, and vend within the United Kingdom of Great Britain and Ireland, the Channel islands, and Isle of Man, an invention for "An improvement in the manufacture of paper," upon the condition, among others, that I, the said Marie Amede Charles Mellier, by an instrument in writing, under my hand and seal, should particularly describe and ascertain the nature of the said invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office, within six calender months next, and imediately after the date of the said letters patent:

Now know ye, that I, the said Marie Amedee Charles Mellier, do hereby declare the nature of the said invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof; that is to say:

This invention has for its object a peculiar process for the treating of straw, and other vegetable fibres requiring like treatment preparatory to the use of such fibres in the manufacture of paper. and the improvement consists in subjecting the straw or other such fibrous material to a pressure of at least seventy pounds on the
449 square inch when boiling such fibrous matters in a solution of caustic alkali. For this purpose the straw or fibrous matters are cut into short lengths, soaked in warm water, and washed. The straw or fibrous substances are then placed in a suitable boiler; and I use for such purpose a rotary boiler, provided with a coil or coils of steam pipe, for the purpose of heating the contents; and I prefer that

the boiling should be carried on at a temperature to produce at or above 80 pounds on the square inch in the boiler, but so high a temperature is not absolutely necessary; but I have found by experiment that it is essential that a temperature equivalent to 70 pounds on the square inch must be employed. The quantity of alkali used is at the rate of about sixteen per cent. of caustic soda or potash of the straw or fibrous substances under process. The fibrous material may then be bleached by the use of a comparatively small quantity of chloride of lime.

Having thus stated the nature of my said invention, I will proceed more fully to describe the manner of performing the same.

The straw, or other fibrous material requiring a like process to prepare the same for the paper manufacture, is first, as heretofore, to be cut, in a chaff-cutting or other machine, into short lengths and to be freed from dust and dirt, and then steeped for a few hours in hot water. The straw or fibrous material and a weak solution of caustic alkali are then to be placed in a suitably close boiler, heated by steam as hereinafter explained, and the heat is to be raised to such a degree as to attain and maintain for a time a pressure internally of the boiler equal to or exceeding seventy pounds on the square inch; that is, about 310° Fahrenheit, by which means a considerable saving of alkali, as well as time and fuel, results, as compared with the means of using a hot solution of caustic alkali, as now practised in preparing straw and other fibres for paper makers.

The boiler employed for this purpose and the manner of heating it by steam may be varied, but the construction of boiler and the arrangement of steam-pipes which is preferred, are as follows: The boiler is cylindrical with hemispherical ends, constructed with hollow axes at the ends, in order that it may be made to rotate slowly in bearings. The boiler is made with a suitable man-hole for charging and discharging the boiler with fibrous and other matters. Near each end of the boiler is fixed a partition, which partitions are connected together by numerous tubes, which are arranged in a
450 circle near the outer circumference of each partition. By this arrangement the steam are introduced through the hollow axis at one end of the boiler, and it passes through the steam-pipes, and thence into the compartment at the other end of the boiler, where it and the condensed steam is conveyed away, as are well understood. Hence the steam does not mix with the caustic alkaline solution in the middle portion of the boiler, but is kept separate, and does not, therefore, in condensing dilute the caustic alkaline solution used. I prefer that there should be a safety-valve on the steam-pipe as near the boiler as may be. The boiler is to be strong and well put together, in order to sustain the necessary pressure, and I prefer to work at a pressure of eighty pounds on the square inch, or about 322° Fahrenheit. The strength of caustic alkaline solution (soda or potash) which I prefer to use is such as will mark from one and a half to three degrees of Beaume, and from seventy to eighty gallons of such solution are used to each cwt. of straw or other similar fibrous matter. The boiler is to be filled with straw and alkaline solution, and

then closed fluid-tight. The boiler is made to revolve slowly, say about one or two revolutions per minute, and the steam is to be admitted. I find it desirable to keep up the heat and pressure during about three hours after the desired pressure above mentioned has been obtained in the boiler, when the process of boiling will be complete; and in order to cool down the apparatus and the fibres under process, before withdrawing the same from the boiler, I shut off the steam and cause water to flow through the tubes, and thus cool the apparatus and the fibres. And in order to remove the alkaline solution and other matters from the fibres, after taking the same from the boiler, I first use the hot water obtained in cooling the apparatus, and then steep the fibre for about an hour in hot water acidulated with a quantity of mineral acid equal to about two per cent. of the fibre under process, and finally the washing is completed with cold water. The straw or fibre may then be bleached in the ordinary manner, and it will be found to be accomplished by a comparatively small quantity of chloride of lime.

Having thus described the nature of my said invention, and the manner of performing the same, I would have it understood that I do not claim the general use of caustic alkaline solutions, nor the employment generally of a close boiler for boiling straw or other
451 fibrous substances; but what I claim is, the subjecting straw or other vegetable fibrous substances (requiring like treatment,) to a boiling process in a weak solution of caustic alkali, under considerable pressure, such as is herein described.

In witness whereof, I, the said Marie Amedee Charles Mellier, have hereunto set my hand and seal, this fifth day of October, in the year of our Lord one thousand eight hundred and fifty-five.

[L. S.] AM. MELLIER.

Witness: S. CARPMAEL.

Exhibit XLVI.—French patent.—Coupier & Mellier.—May 17, 1851.

Brevet d' Invention. 5,605. Patent fifteen years; dated May 17. 1851, to Messieurs Cooper et Mellier, of Paris, for methods of reducing vegetable fibres to pulp suitable for making white paper.

A preliminary process, more especially applicable to the treatment of herbaceous materials, and different kinds of bark, although it can be applied equally well to the treatment of wood, consists in the use of a solution of hydrate of soda or of potash, marking from eight to ten degrees by the areometer of Beaumé.

The material under treatment is to be submitted to the action of this solution during eight or ten hours, and at a temperature of one hundred to one hundred and ten degrees centigrade.

After these liquids are drawn off (the use of which we shall presently speak of,) the material is carefully washed until the water comes away clear. The material, which is then sufficiently disorganized, is placed in a bath of hypochlorite of allumina, in the proportion of eight or ten kilograms of this hypochlorite, in a dry state, to one hundred kilograms of the raw material.

By leaving the material for about eight hours in this bath, (where it is kept in motion so that all the fibres may be the better acted upon,) a pulp is obtained which is of a beautiful whiteness and of great purity. It is then drained, and after being washed in boiling water, (which decomposes the hypochlorite remaining in the pulp, 452 and accomplishes also the disintegration of the woody fibres,) it only remains to make this pulp fine by any of the means used ordinarily for rag pulp, taking care however, that the blades of the cylinder and plate which are used be rounded.

In this condition, the pulp can be employed mixed with pulp from rags, in variable proportions, and will produce excellent paper.

The liquids that are drawn off, as well as the first washing waters, are placed to evaporate in the basin of a referberatory furnace, until they are of a thick consistency. There is thus obtained a resinous soap that either alone or mixed with tan or charcoal dust furnishes a fuel that can easily be made use of in the furnace itself to aid the evaporation of the liquors of a subsequent process. The ashes resulting from the combustion of this soap render up by lixiviation, almost all the alkali which has been used in the operation, for the loss does not amount to more than fifteen or twenty per cent. of the quantity used.

The advantages of the process which we have just described, consist,

First, in the simplicity of performing the operations, and in the economy that results from it, but particularly—

1st, In the employment of the solution of hydrate of soda, or potash, of the strength we have mentioned.

2nd. In the use of the hypochlorate of alumina, also of the strength mentioned. It is this which constitutes the merit of our invention.

In this concentrated condition, the alkaline hydrate dissolves completely the resinous matter contained in the vegetables, and frees the silica and earthy salts, leaving the woody fibres bare, so that they can be bleached, without any other intermediate operation, with a solution of hypochlorate of alumina. We insist upon the use of this hypochlorate, in preference to any other, on account of the readiness with which the alumina, which is a feeble base, yields its hypochorous acid, whence results,

1st. A very great rapidity in the operation.

2nd. A more perfect whiteness.

Nevertheless, this bleaching can be done more or less completely with other hypochlorites.

As regards the mode of using these two agents, the alkaline hydrates and hypochlorates, mentioned above; that is to say, as far as the form of the apparatus is concerned in which the operation is performed, that may vary very much; the best system to follow will be that which shall allow, upon a given quantity of vegetable material, the employment of the least possible amount of liquid. So for the alkaline hydrate wood, the means which has seemed to us preferable for this use, as well as in its application to the washing of cords and rags in paper making, consists in throwing upon the materials to be treated, through a watering pot, and by means of the pressure of

steam, or often additional force, resulting from ebulition in a close vessel, a quantity of liquid which, after having passed through the mass, re-enters the vessel from which it has been thrown, so as to be thrown out again, and so on, until the disorganization of the vegetable materials is complete. By this means, the quantity of liquid employed can be reduced to about 300 litres for 100 kilograms of raw material, and the expense of evaporation considerably diminished.

As to the hypochlorite bath, this can be made in various ways, in agitators like those used in paper factories, or wooden cylinders, or with any other apparatus of like sort. The less water, of course the more concentrated a liquor will be, and the more rapid and complete will be the action. The proportion of water ought not, in any case, to exceed 600 litres to 100 kilograms of raw material. If straw is to be treated, it must be carefully cleaned and freed from the parasitic herbs that it may have with it. We should also remark that there is an advantage in cutting the straw with the common straw-cutter, the action, in this way, seeming to be more uniform, and the "knots," particularly, being thus reached more from the bottom.

Nevertheless, we can entirely dispense with the use of it, especially if the straw is first submitted to the rolling that shall crush the "knots" themselves and open them, thus making their interior parts more easily reached by the action of the alkaline hydrates. But neither of these two operations are absolutely indispensable.

The second process, more particularly applicable to the treatment of wood, consists in the use of nitric acid for the reduction to pulp of the material under treatment, and also in the extraction of the oxalic acid that can be gotten from the liquors by evaporation; farther, of an acid analagous to "nitro picrique," as a product useful in coloring woolens and silks.

The material to be treated, after being properly divided up, is to be submitted to the action of a solution of nitric acid, marking about 5 to 6 degrees of strength.

Wood, for example, is taken that has been split or planed, and the chipping heaped up in wooden tubs, so as to leave the least possible space unfilled; two tubs are thus filled.

These tubs are provided, with false wooden bottoms, perforated, and raised about 5 centimeters above the bottom, and also with covers, joining as accurately as possible upon leathern edges.

These covers are themselves provided with a grate, or false perforated wooden cover, which shall pass easily into the tub, and descend in it to a depth of about 20 centimetres, so as to leave between the true cover and false cover an empty space.

The two tubs being charged, into one of them is turned nitric acid, held in water, and marking from 5 to 6 degrees of strength, by the measure of acids, so as to wet the whole mass. This is then left to act for about four hours, and then the liquor carried to a boiling point, by means of a jet of steam coming in through the bottom of the tub; the boiling is to be kept up about two hours. During this operation, abundant nitrous vapors are evolved, which are made to pass into the second tub, through a connection of stone or of lead, lead-

ing from the top of the tub being in action, up through the bottom of the second one. Care must be taken that the material in the second tub be first moistened. A current of air, fed by a fan-wheel, is led into the bottom of the second tub, so as to transform the nitrous vapors into hyponitric acid, which aids in preparing the material which will be treated in the operation following.

When the operation is finished, the liquor is drained off, so that it may be immediately poured into the second tub.

After the draining is completed, the material is washed, and then carried in a tub, furnished with a wire cloth resting upon the wooden grating that serves as false-bottom, so to receive the action of a solution of hydrate of soda or of potash, marking 1 or 2 degrees by the areometer—carried up to the boiling point during about two hours, then it is washed and carried in a proper receptacle to be bleached, as has been described in the first process. Only the dose of hypochlorite of alumina to be used for 100 kilograms of raw material is reduced here to 4 or 5 kilograms of dry hypochlorite. The pulp so obtained, can be employed as was previously stated.

The material filling the second tub having received the action of the nitrous vapors, is submitted to an operation precisely similar, except that there has been added with the liquor coming from the first cask a quantity of nitric acid of 36 degrees, equivalent to 40 per cent. of the weight of the raw material.

These operations can be thus continued, with the same liquids, eight or ten times. At the end of this time, the liquor having been sufficiently concentrated for evaporation, new liquors must be used.

This evaporation can take place in a water bath, in stone vessels, and in cooling, one obtains crystalized oxalic acid that is purified by the ordinary process.

The mother-water, contains the coloring matter, to which we called attention above.

The kinds of wood best adapted to this kind of treatment are the beech, the fir, and the witch.

The merit of the second process consists in the use of nitric acid, of great strength, in the utilizing the nitrous vapors, and in obtaining, in addition to the pulp, a coloring matter, very rich, and also oxalic acid.

Additional certificate.—Dec. 12, 1851.

Certain details having appeared to be of moment, to be given upon our system of preparing paper pulp, we make of them now the subject of a patent for additional improvement.

Thus, in the enumeration of the advantages of our invention, we omitted to particularize the following:

1st. The substitution of chemical agents for mechanical force in the reduction of the materials to pulp, a substitution of which the importance is to be estimated by the result. One can manufacture, with a maximum force of six horses, 1,000 kilograms of fine paper pulp, for which usually there is required a force of twenty-five or thirty horses.

2nd. The reproduction of the alkali rendered possible, at a trifling expense, by the small quantity of liquid which the apparatus admits of our using, and of which we shall give a full description presently.

3d. The possibility of procuring, by operating in a close vessel, the combustion of soaps from the evaporation of the liquors, a considerable quantity of carburetted hydrogen gas, which can be utilized for lighting, or applies to heating the steam apparatus.

In the summary description that we made of the apparatus, which seemed to us most convenient for operating upon the straw, with alkaline hydrate, we should have added the following details, that render our ideas more clearly:

The apparatus, which is very simple, consists of a closed iron vessel, the form of which may be different; this vessel is provided with a hollow vertical shaft, of iron or copper, which goes down through the vessel to within 4 centimetres of the bottom, and rises again on a level with the top of the vessel, where are placed the materials to be treated. One end of this moveable column is adjusted by a set-screw; this branch terminates in a watering-pot head, which comes to the center of the vessel. Heating by steam, through a worm, the liquid introduced into the vessel or boiler, a pressure is exerted which forces the liquid to pass through the hollow shaft, in order to reach and expand itself in the receptacle for the material.

This vessel, elevated some centimetres above the boiler, is provided with a false-bottom or grating, covered with wire-cloth, upon which rests the material to be treated.

A pipe, starting out from under this false bottom and going to the bottom of the boiler, where it terminates in a valve, allows the liquor to re-enter as soon as the sprinkling is terminated.

This re-entrance of the liquor is easily made as soon as the cock of the feed-pipe is shut.

[This description is very foggy, and not easily understood without drawings. The text of the original is closely and exactly followed.]

TRANSLATOR.

Thus, as we have remarked, we can by this means reduce considerably the amount of liquid to be employed.

We have suggested the utility of cutting the straw; we now insist upon the necessity of doing this, so as to be able, by means of a winnowing-mill, to extract all those "knots" which are more difficult to reduce, and particularly the seeds, which remain in very great quantity in the straw, occasioning a considerable loss, and giving to the pulp a heavy and gluey character, which renders its manufacture much more difficult.

By means of this operation that can be very readily performed, provided the winnowing-mill is conveniently arranged, the crushing of the straw is rendered no longer of great utility.

But one can perfectly well dispense with this operation, itself, if he will proceed in the following way:

All the spikes are to be removed from the straw, whither the head of the bundle is cut in a mass, or, which is much better, the spikes

are collected in bunches at the same time that the straw is cleaned. Now the bundle is cut into two parts only, and the straw, thus cut, is placed endwise in the vessel. From this arrangement of the straw results a much greater facility of entrance for the liquids in the boiler.

The boiling is performed just as we have described in our specification. Then, after washing, the material is dried and pressed, in order to force out all the water possible.

The straw is then arranged upon screens in a chambered chest or closet, such is used for bleaching rags with chlorine, care being taken to prevent it from forming bunches.

Then there is let onto it a current of hypochlorous acid gas; that is obtained in different ways, and among others, by letting hydrochloric acid fall slowly into hypochlorite of lime, diluted with about its weight of water; the acid must fall drop by drop.

The proportion of hypochlorite of lime to be used is 10 to 12 kilograms to 100 kilograms of straw; that of the acid, one and a half times the weight of the hypochlorite.

After the washing, the material is put in a bath of hypochlorite of alumina, as was described in our patent.

The hypochlorous acid gas has a marked advantage over chlorine in the bleaching of the straw and vegetable materials.

This advantage consists in this:

1st. In bleaching with chlorine gas all the chlorine set free transforms itself by contact with the hydrogenized material, or with the water contained in the pulp, into hydrochloric acid.

As the hydrochlorous acid contains only half the chlorine and half the oxygen, which acts directly, it results from this that it forms half less hydrochloric acid, whose presence in the pulp is injurious, and which only be gotten rid of by prolonged bleachings.

Exhibit XLVII.—No. 11,34.3

THE U. STATES PATENT OFFICE:

To all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the records of this office of the letters patent granted Charles Watt and Hugh Burgess, July 18, 1854, No. 11,343.

In testimony whereof, I, D. P. Holloway, Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed this sixteenth day of March, in the year of our Lord one thousand eight hundred and sixty-three, and of the independence of the United States the eighty-seventh.

[SEAL.] D. P. HOLLOWAY.

The United States of America to all whom these letters patent shall come:

Whereas Charles Watt and Hugh Burgess, of London, England, have alleged that they have invented a new and useful improvement in the manufacture of paper from wood, which they state has not been known or used before their application, have made affirmation

that they are subjects of the Queen of Great Britain, that they do verily believe that they are the original and first inventors or discoverers of the said improvement, and that the same hath not, to the best of their knowledge and belief, been previously known or used; have paid into the Treasury of the United States the sum of five hundred dollars, and presented a petition to the Commissioner of Patents, signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose.

These are therefore to grant, according to law, to the said Charles Watt and Hugh Burgess, their heirs, administrators, or assigns, for the term of fourteen years from the nineteenth day of August,
453 one thousand eight hundred and fifty-three, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said improvement, a description whereof is given in the words of the said Watt and Burgess in the schedule hereunto annexed, and is made part of these presents.

In testimony whereof, I have caused these letters patent to be made patent, and the seal of the Patent Office has been hereunto affixed.

Given under my hand, at the city of Washington, this eighteenth day of July, in the year of our Lord one thousand eight hundred and fifty-four, and of the independence of the United States of America the seventy-ninth.

[L. S.] ROBERT McCLELLAND,
Secretary of the Interior.

Countersigned and sealed with the seal of the Patent Office.
C. MASON, *Commissioner of Patents.*

The schedule referred to in these letters patent and making part of the same.

To all whom it may concern:

Be it known that we, Charles Watt, of the city of London, in the county of Middlesex, and Hugh Burgess, of the city of London, in the county of Middlesex, and Kingdom of Great Britain, have invented, made, and applied to use, certain improvements in pulping and disintegrating vegetable substances for which letters patent have been granted to us by her Majesty, the Queen of Great Britain, bearing date the day of , one thousand eight hundred and . And we do hereby declare that the following specification (being the same on which letters patent were granted) is a full, clear, and exact description of the same.

The wood or vegetable substances upon which it is intended to operate by this process should first be reduced to very fine shavings or cuttings, the finer the better. This may be done in any suitable machine.

The shavings are then to be boiled in a solution of caustic alkali, the strength of which, being dependent on the nature of vegetable substances operated on, can only be learned by experience. For deal

or fir wood, we find that a solution of alkali of the strength indicated by twelve degrees of the English hydrometer answers very well. The length of time necessary for this part of the process is somewhat dependent on the nature of the vegetable substance to be treated. We find boiling in a solution of caustic alkali under pressure of considerable service. We do not claim this operation as a part of our invention. The shavings are then to be well washed and
454 pressed, and the washings may be saved and evaporated down and burned in a suitable furnace, when they are again available for the same purpose. The damp shavings are now to be exposed to the action of chlorine, or the compounds of chlorine with oxygen, till on a portion being placed in a dilute solution of caustic alkali the vegetable substance falls into a dark pulpy mass. This part of the process is conveniently effected by placing the damp shavings on racks or drawers, about nine inches apart, one above another, arranged in a chamber, and allowing the chlorine or the compounds of chlorine with oxygen to enter the chamber and fill it. Of the compounds of cholrine with oxygen, we prefer that known as protoxide of chlorine or hypochlorous or chlorous acid or euchlorine. If found more convenient, the chlorine or the compounds of chlorine with oxygen may be used in aqueous solution, instead of the gaseous form.

As soon as the shavings have been sufficiently acted upon by the gas, as may be ascertained by the method above described, they may be removed, and the hydrochloric, which is the result of the above process removed by washing, and the shavings well pressed. This should be done with a little water as possible, as this acid may be saved and made use of for the reproduction of chlorine. The shavings are now to be placed in a weak solution of caustic alkali, when they will fall into a pulpy mass of dark brown color. This part of the process may be expedited by exposing this mass to the action of a beater or "engine," placed in the tank containing the solution of alkali.

The pulp thus obtained as above described, having been freed from the alkali by washing, (which may be saved as before directed,) may now be bleached by the usual process, or, as we prefer, by chlorite or hypochlorite of soda or potash, liberating the chlorous or hypochlorous acid by hydrochloric acid.

Having thus fully described the nature of our invention and shown how the same may be reduced to practice, we wish it to be distinctly understood that we do not confine our claim to the apparatus, or utensils, or the manipulations herein named, as they may be varied to suit the circumstances of the case.

But what we do claim as of our invention, and desire to secure by letters patent, is the pulping and disintegrating of shavings of wood and other similar vegetable matter, for making paper by treating them with caustic alkali, chlorine simple or its compounds, with oxygen and alkali, in the order substantially as described.

455 In witness whereof we have set our signatures this sixth

day of January, in the year one thousand eight hundred and fifty-four, in the presence of two subscribing witnesses.

[L. S.] CHARLES WATT.
[L. S.] HUGH BURGESS.

Witnesses:

WILLIAM LEWIS,
8 *St. Albans Terrace, Kensington.*
JOHN WATT,
1 *Ampton street, Gray's Inn Road.*

Exhibit XLVIII.

THE U. STATES PATENT OFFICE:

To all persons to whom these presents shall come greeting:

This is to certify, that the annexed is a true copy from the files of this office, of the correspondence in the matter of the letters patent, granted Watt and Burgess, July 18, 1854.

In testimony whereof I, John L. Hayes, acting Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed this twentieth day of May, in the year of our Lord one thousand eight hundred and sixty-three, and of the independence of the United States the eighty-seventh.

[SEAL.] JOHN L. HAYES.

U. S. PATENT OFFICE, *February 6th* 1854.

SIR: Your application for letters patent for an alleged improvement in making paper, is at hand. However, there being no evidence filed that a patent had been granted you in England for the subject of your present application, you are requested to furnish such evidence, if you desire your case to have precedence, and be examined at once.

Yours, respectfully,
C. MASON, *Commissioner.*

Messrs. WATT and BURGESS,
Care of A. B. Stoughton, Esq., Washington, D. C.

WASHINGTON, *Feb. 11th*, 1854.

Hon. CHAS. MASON, *Commissioner of Patents,*

SIR: In reply to yours of the 6th inst., in relation to the application of Watt and Burgess for making pulp for paper, I have the honor to enclose you the within affidavit of Mr. Burgess, one of the inventors.

Very respectfuly,
A. B. HOUGHTON,
Attorney for Watt & Burgess.

U. S. PATENT OFFICE, *February 16th*, 1854.

SIS: The specification and claim of your application for
456 alleged improvements in treating fibre for paper stuff have been duly examined, and it is found that you have not sent

any specimens that indicate the stages of the operation. There must be sent, in quantity sufficient for experimenting with, a specimen of the crude fibre, ready to be treated by alkali; a specimen of the fibre ready to be converted into brown pulp; a specimen of the brown pulp, made by treating the fibre in the way described, and say how long so treated, and whether with chlorine or euchlorine.

A specimen of the pulp bleached afterwards with chlorine, and say how bleached, if any peculiarity about it. The case is postponed till the specimens are received.

Yours, &c.,
C. MASON, *Commissioner.*

Messrs. WATT & BURGESS,
Care of A, B. Stoughton, Esq., Washington, D. C.

WASHINGTON, *March 10th*, 1854.

Hon. CHAS, MASON, *Commissioner of Patents.*

SIR: Herewith I have the honor to present to the office, in compliance with your instructions of the 16th ult., specimens of the material in its various stages, in the matter of the application of Watt & Burgess, for making pulp for paper.

No. 1 contains shavings boiled in alkali.

No. 2 is No. 1 treated with chlorine.

No. 3 is No. 2 treated with alkaline by forming the pulp.

No. 4 is the pulp bleached.

The bleaching process completes the formation of the pulp; that is to say, any portion which may not be completely pulped by the 3d process, is finished by the 4th.

Very respectfully,
A. B. STOUGHTON,
For Watt & Burgess.

U. S. PATENT OFFICE, *March 24th*, 1854.

SIR: Your specification for a patent for treating wood fibre by alkali and chlorine, or its compounds, with oxygen, is herewith returned to you for explanation, as noted on the margin thereof, and for a clear and distinct expression of what the novelty in your devices is confined to, both in the specifying of the nature of the invention, and the setting forth of the claim. There are at least
457 forty applications for patents, or patents themselves on record for process of treating vegetable fibre, and in a large part of these, alkali and chlorine and its compounds are used. Under these circumstances, the statement of the nature of the invention, the disclaimer, and the claim do little to distinguish any novelty in the invention.

Instead, therefore, of rejecting your claim, as must inevitably be done, if decided on in its present form, the papers are given to you, for your further action in the case.

Yours, respectfully,
C. MASON, *Commissioner.*

Messrs. WATT & BURGESS,
Care of A. B. Stoughton, Esq., Washington, D. C.

WASHINGTON, *April 7th*, 1854.

Hon. CHAS. MASON, *Commissioner of Patents.*

SIR: In compliance with your letter of the 24th ult., and the pencil notes on the margin of Watt & Burgeas' specification for pulping, &c., vegetable matter, I would state, that their invention relates to a series, or combination of processes in the order in which they are stated, for treating shavings, &c., for the purpose of reducing them from their crude state to a pulp, ready to be made into paper. The several processes through which the shavings pass may be enumerated in the following order, viz:

First. The shavings are boiled in a solution of caustic alkali, until, by the test of washing, they have lost their woody taste, (for white pine shavings, but three hours) when they are washed and pressed to rid them of the alkali.

Second. They are then subjected to the action of chlorine, or its compounds, and oxygen, until by testing a portion in a dilute solution of caustic alkali, it falls into a dark pulpy mass, when it is again washed and pressed to remove the hydrochloric acid, which is the result of this process.

Third. The material is then subjected to a weak solution of caustic alkali, when it falls into a pulpy mass of a dark brown color. It is then again washed to free it of the alkali, and may be bleached by any of the known processes.

The shavings must pass through these several processes,
458 and in the order stated, and this constitues the invention.

The processes, taken separately, will not produce the article, but their sum will, and they are only claimed in their series, and not in their individual capacities. It is admitted that alkali and chlorine have been used in pulping vegetable matter. But it is not known that alkali, chlorine, oxygen and alkali, have been used in the manner, and in the order in which Messrs. Watt & Burgess use them. This order and series of processes is what, therefore, constitutes their invention, and what they suppose they have embodied in their claim, but are willing to meet the views of the office in defining their invention, if they have not already done so, by the description and the present explanations.

These processes may be expedited, by additional means, as they have described, but this is a question of economy, and not of invention.

Very respectfully,

A. B. STOUGHTON,
For Watt and Burgess.

The specification is herewith returned, the pencil note thereon being answered in the "first" of the series of processes.

U. S. PATENT OFFICE, *April* 19, 1854.

SIR:—Yours of the 7th inst., explaining somewhat at length, that your invention contains nothing novel, in the several individual steps of the process, but that it consists in the succession of the steps of

the process, but that it consists in the succession of the steps themselves, has been duly considered. In reply you are referred to the following extract from Regnault's Chemistry, vol. 2d, pp. 447–48:

"The substance, (meaning cellulose, or ultimate fibre of wood) when obtained in as disaggregated form as possible, is digested with hot solution of caustic potash, or soda, and after washing the residue, is treated with week hydrochloric acid, and washed with water. By repeating this process a certain number of times, the wood fibre may be completely removed (that is from the cellulose or ultimate fibre.) Although the same result may be obtained more quickly by subjecting the substance to the more powerful oxidizing re-agents, such as the week solutions of chlorine gas, as hypochlorite of lime, and following each of these treatments by an alkaline solution and dilute hydrochloric acid."

459 This quotation shows that you are anticipated in your invention. The claim is therefore refused.

Yours, respectfully,

S. T. SHUGERT,
Acting Commissioner.

Messrs. WATT & BURGESS,
Care of A. B. Stoughton, Esq., Washington D. O.

WASHINGTON, *May 10th*, 1854.

Hon. CHAS. MASON, *Commissioner of Patents.*

SIR: I have to acknowledge receipt of the official letter of your officer, refusing the claim of Watt & Burgess for making paper pulp. With due respect for the opinions of the office, I am obliged to differ with them in the relevancy of the reference given for such rejection.

In "Regnault's Chemistry," referred to by the office, is mentioned a scientific fact, which, if it had been the same essentially, as described and claimed by Watt & Burgess, ought not, and could not, under the multitude of decisions by the courts, be adduced as a barrier to the grant of letters patent for an actual bona fide result. A scientific fact may lie buried in the books for years, and the world be none the wiser for it. It is the actual reduction of that fact to practice, the benefiting of the world at large by establishing the practicability and feasibility of that fact that constitutes invention. The world at large might be at this day totally ignorant of a magnetic telegraph, so far as the books are concerned, (although they mentioned the fact that a magnetic current would pass over proper conductors,) had not practical invention stepped in and filled up the blank.

But the reference given is not the same thing claimed by Messrs. Watt & Burgess. And if the office had given the whole of the paragraph referred to, this would be self evident. The last sentence of the paragraph says as follows: "It is washed successively with alcohol and ether to dissolve the fatty matter." This of itself is sufficient to defeat the practical use of the process described by Regnault. An article of manufacture or commerce produced thus expensively

could not compete with any of the present known methods. Messrs. Watt & Burgess do not use alcohol and ether, if they did, their alleged invention would be useless, except as a scientiffc fact. But by avoiding the use of expensive chemicals, or difficult or uncertain
460 chemical processes, they produce a valuable article at much less prices than has heretofore ever been done. This they can prove to the office if required.

But the difference in the processes described in Regnault, and those claimed by Watt & Burgess, are not confined solely to the use and disuse of alcohol and ether. Regnault says, in speaking of the cellulose, that it "is digested with hot solutions of caustic, potassa, or soda, and after washing the residue, is treated with weak chlorohydric acid and washed with water. By a repetition of this process for a certain number of times, the woody fibre may be completely removed."

Now, this repetition of the process is not used by Watt & Burgess at all, and they consequently save the expense and time of so doing.

The office may assert that, Regnault goes further, and says that the process may be quickened by using "more powerful oxydizing re-agents." It is admitted, but even then "each of these treatments" (must be followed) "with an alkaline solution and dilute chlorohydric acid." Here, then, is a striking difference between the two processes.

But further, Regnault says, "although these various re-agents attack the cellular tissue itself, the action is much less active than on the substance surrounding it; so that if the operation be carefully conducted and re-agents diluted with water be alone used, the greater portion of the cellulose escapes destruction."

Now, the office must admit that the whole description of the process in Regnault is a scientific fact only, which might in a laboratory, under skillful hands, produce a pulp, at a cost 500 per cent. above the cost of a better known article. He says, "the greater portion of the cellulose escapes destruction" under his process. Now, a fraction over one-half will be the greater portion, and such a saving for an article to be manufactured and go into general use, would amount to a total non use of the article. For all practical purposes, then, the process in Regnault is useless. Messrs. Watt & Burgess produce a pulp equally, as good for very many purposes, as rag pulp, and at a cost of nearly 20 per cent. less than rag pulp. By their process the shavings are reduced to pulp in twelve hours; and in six hours more it is bleached and ready to be made into paper.

Besides, by their process, it is a mere question of time, and not of a carefully conducted operation, and they do not lose any appreciable portion of the cellulose.

461 The office has been very particular (and I do do not mention it in the way of censure, for I think it but proper) to require Messrs. Watt & Burgess to state their process in the most exact terms, "how long they boil in alkali?" whether they "regard the oxide as the equivalent of the chlorine?" "how they use it?" "how

they prepare it?" "How do you use or prepare the aqueous chlorine?" "is the chloride of lime in solution," &c. None of these things are stated in Regnault, and yet it is decided to be the same as Watt & Burgess. They show a feasible, practical, and cheap method of producing pulp, and are met by a scientific abstraction, which at most will make but a costly experiment.

The claim of Watt & Burgess covers their invention as they understand it, and consists in the use of caustic alkali, chlorine, or its compounds, with oxygen, and alkali in the order described. There is no such succession of chemical appliances mentioned in Regnault, nor can such results be produced by the process in Regnault, as Watt & Burgess produce by their simple, certain and cheap process. They therefore ask a reconsideration of their application at your earliest convenience. The specification is returned.

Very respectfully,

A. B. STOUGHTON,
Attorney for Watt & Burgess.

U. S. PATENT OFFICE, *May 15th*, 1854.

SIR:—Your letter of the 10th inst. replying to the official letter rejecting your claim to the process of making paper pulp, is duly received.

Your object to the reference found in Regnault's Chemistry, and denominate it a "scientific abstraction," as though a process published in a book of science is less a publication than it would be if published in a Patent Office report. The reference is a "printed publication," and although for obvious reasons (namely, that of seperating all foreign matters whatever from the pure cellulose by means of alcohol and ether,) the process is carried further in the description in Regnault than you may find it profitable to do. Still your process, you must admit, is therein embraced. You indicate a want of fairness in the office in not quoting, in the reference the use of the alcohol and ether to remove the last proportions of fatty matter,
462 which is an extra treatment, only required when cellulose in perfect purity is called for, and which could never be used in connection with the previous treatment of alkalies, chlorine and acids. There was, therefore, no necessity, and would have been no pertinency in introducing the alcoholic and ethereal treatment in the reference of the office.

You complain of the reference because you say you do not repeat the process of digesting the fibre in the chemicals used, while the reference says that by the repetition of the process the woody fibre may be completely removed. Now, the repetition of the process is only necessary where all the woody fibre matter is to be removed, leaving only the cellulose. Although you may be satisfied with using the process without repetition, it is still a process, and is still a pertinent reference. The queries made in the official letter might have been made in a separate letter, it is true, but they were inserted here that if there were any facts connected with them not yet developed in the case, they might be brought out by these queries, and

that would save writing an extra letter. In fine, the office does not perceive any justifiable ground for changing its action is this case.

Respectfully yours,

C. MASON, *Commissioner.*

Messrs. WATT & BURGESS,
Care of A. B. Stoughton, Esq., Washington, D. C.

WASHINGTON, *July* 18, 1854.

Hon. COMMISSIONER OF PATENTS:

Will please forward the patent of Messrs. Watt & Burgess, to the care of F. B. Houghton, esq., No. 4, New street, New York, and much oblige,

Yours, &c.,

A. B. STOUGHTON.

463 *Exhibit X¹.—C. S.*

The U. States Patent Office to all persons to whom these present shall come, greeting:

This is to certify that the annexed is a true copy from the records of this office.

In testimony whereof, I, T. C. Theaker, Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed this twentieth day of September, in the year of our Lord one thousand eight hundred and sixty-seven, and of the independence of the United States ninety-second.

[SEAL.] T. C. THEAKER.

464 *Examiner's report on extension.*

UNITED STATES PATENT OFFICE,
EXAMINER'S ROOM NO. 2.
August 12*th*, 1867.

Application of Chas. Watt and Hugh Burgess for an extension of patent granted to them July 18th, 1854, ante-dated August 19th, 1853, for improvement in the manufacture of paper from wood, and twice reissued.

In this case a large amount of testimony has been filed relating principally to the question of novelty of the invention, and to technical matters affecting the validity of the patent. The utility of the invention, as now practised by the owners of the patent, is fully proved and conceded. In settling the question of novelty, the chief difficulty is in ascertaining what the patent properly covers. As originally issued, the specification was so defective as to cover little of any value, in the art of making paper pulp. The first reissue gave a much more practical description, and the last reissue added considerably to this. The principal facts relied upon by the applicants

to sustain their patents are: 1st, that they, before the issue of their patent in this country, made paper from wood, entirely free from intercellular matter, wholly by chemical re-agents; and 2d, that they have made the manufacture of such paper a commercial success, and thereby became practically the inventors of such paper.

So far as regards this country, it is true that the manufacture of wood paper was but little known or used till within the period covered by the lifetime of this patent, and only during the last four years of this period has the manufacture been carried on to any considerabled extent.

There were, however, many attempts to produce paper from wood and other fibrous vegetable materials, both in this country and in Europe. Several of the earlier inventors assert that they did make true pulp from wood, though not in the way now practised by the applicants.

Owing to the large number of previous inventions cited it is impossible to notice each in detail. Those are therefore selected which are regarded as most important. They are the French patent of Montgolfier Freres, February 7th, 1838, with addition, October 16th, 1838; that of Gros, March 20th, 1847; Dubochet, September 20th, 1540; and Coupier and Mellier, May 17th, 1851.

There seems to be no good reason to doubt that Montgolfier's process did separate pure fibre from wood, and by means
465 quite similar to those employed by the applicants. He employed caustic alkali and high pressure, which, if it did not wholly free the wood from intercellular matter, the subsequent treatment with alkali and chlorine could complete the process so as to produce wood fibre, substantially the same as claimed by the applicants, but perhaps at a greater cost. The process of Gros also produces such a fibre by nearly the same process as used by Montgolfier; the chief difference being that he does not apply it to a true wood. In the patent of Coupier and Mellier a process is described almost identical with that now employed by the applicants, except that the temperature is lower, but still sufficient to produce pure fibre from straw and similar materials. Dubochet employs a similar process, and applies it to what he calls reeds.

These references seem to settle that wood fibre suitable for making paper had been produced by boiling in caustic alkali under pressure as one of the preparatory processes.

This process was successfully used to make paper of good quality from straw before the date of the patent of Watt & Burgess. (See Central Blatter fur Deutsche Papier Fabrication, September 27th, 1852, page 449, and was well known and used in this country before the successful establishment of a manufacture under the applicant's patent. Notwithstanding these very serious objections on the score of novelty, the applicants, or their legal representatives, seem to be the first manufacturers in large quantities of real paper pulp from true wood. They have succeeded in this by numerous and long-continued experiments and expenditure of large sums of money, and have thereby materially advanced their art.

The specification of the reissue, when interpreted by itself, seems too broad in the claim. The correspondence in the case is wholly in regard to paper from wood, but as that term might, under some circumstances, be too limited, the words "other vegetable substances" were added. But these words, without some further definition in addition to anything contained in the specification or correspondence, clearly make the claim too broad.

In regard to compensation, the applicants account only for what they received from the sale to Houghton; but it appears from the testimony that Mr. Burgess has received other valuable considerations in connection with the working of the patent, but no attempt is made to fix the exact amount.

After a full review of the testimony and exhibits in the case it appears that, in the manufacture of paper and paper pulp from wood, the applicants have made a valuable improvement, and that they have used due diligence in introducing their invention to the public, and have not been fully rewarded in proportion to the value of the improvement and the cost of making and introducing it.

Were the specification sufficiently full and definite there does not seem to be any objection to granting the extension.

(Signed) B. S. HEDRICK, *Examiner.*

466 The United States Patent Office to all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy, from the files of this office, of the file wrapper and correspondence in re., the reissued letters patent granted Ladd & Keen, ass'ees of F. B. Houghton, ass'ees of C. Watt & H. Burgess, Oct'r 5th, 1858, No. 608.

In testimony whereof, I, T. C. Theaker, Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed this fourth day of August, in the year of our Lord one thousand eight hundred and sixty-six, and of the independence of the United States the ninety-first.

[SEAL.] T. C. THEAKER.

UNITED STATES PATENT OFFICE, *Sept.* 21, 1858.

Messrs. LADD and KEEN,
Care of A. B. Stoughton, Washington, D. C.:

GENTLEMEN: Your application for reissue of letters patent granted to Watt and Burgess, for improvements in treatment of vege-
467 able substances for paper pulp, is herewith returned for amendment by confining the claim to "shavings of wood and other similar matter," as in original patent. A claim to the pulping vegetable substances broadly was not contemplated in the original application.

Respectfully,

———— ————.

WASHINGTON, *Sept.* 22*d*, 1858.

Hon. J. HOLT, *Commissioner of Patents:*

SIR: Yours of the 21st, returning the application of Ladd and Keen's reissue for amendment of the claim, is received. I have to request that the subjoined amendments may be made thereto. Specification herewith returned.

Respectfully,

A. B. STOUGHTON, *Attorney.*

Amend the specification of Ladd and Keen, assignees of Watt and Burgess, for a reissue, as follows:

Page 4, line 16, after the word "of" erase the words "vegetable substances," and substitute therefor the words "shavings of wood and other similar vegetable matter for making paper.

22d Sept., 1858.

A. B. STOUGHTON.

Reissue—4,568, *No.* 608.

Wm. F. Ladd and Morris L. Keen, assignees of Fred'k B. Houghton, assignee of Charles Watt and Hugh Burgess.

Of New York, &c.
County of "
State of "

MANUFACTURE OF PAPER FROM WOOD.

Received September 14, 1858.
Petition " " "
Affidavit " " "
Specification " " "
Drawing.
Copy old patent.
Cert. dep.
1 Cash $15, Sept. 14, 1858.
Examined. Thos. Antisell, Sept. 21, 1858.
2 Issue. H. McCormick, Sept. 24, 1858.
4 Patented, July 18, 1854.
Patented in England Aug. 19, 1853. Reissued Oct. 5, 1858.
Recorded, vol. vi, page 1.

A. B. STOUGHTON,
Washington, D. C.

468
469

470 *Defendants' Exhibit LI.*

This is a copy of a rough draft of an English specification, referred to in the deposition of H. Burgess' answer in chief, No. 6.

HUGH BURGESS.

Attest: CHARLES SERGEANT,
U. S. Commissioner.

The wood upon which it is intended to operate by this pro-
471 cess should first be reduced to very fine shavings; the finer the better. This may be done by any suitable machine. The shavings should then be boiled in caustic alkali, of the strength indicated by about 12 of the English hydrometer. This process is much better performed under pressure, after the wood has been boiled for about twenty-four hours, (but we do not confine ourselves to this time, as it varies with the nature of the wood and amount of pressure, &c.) It should be well washed and squeezed, to remove all the alkali. It is then placed in a chamber furnished with racks, about nine inches apart, upon which the wood is placed and exposed to the action of chlorine, or any of the compounds of chlorine, with oxygen, however obtained. The wood should be exposed to the action of chlorine, or its compounds with oxygen, until it assumes an orange color and falls into a pulpy mass, on the addition of caustic alkali.

The following plan we find to be a convenient and economical means of obtaining the chlorine:

A certain quantity of chloride of calcium (muriate of lime) is to be mixed with the quantity of chromic acid necessary for its mutual decomposition of chloride calcium, chromic acid, which latter acid may be prepared from rough chromate of potash, or soda, or the chromate residue from the bleaching of palm oil or tallow with chromic acid. This mixture is then heated in a suitable retort, when a large quantity of chlorine is given off, the mass is to be heated to dryness, which is best done in clay gas retort, till no more chlorine is given off. The mass, which is now composed of chromate of lime and chloride of chromium, should be powdered and placed on an iron plate, exposed to a cherry-red heat; or this may be done in a retort, taking care that there is a supply of atmospheric air brought to play upon or through the powder. This heat must be continued till the powder turns of a yellowish-brown color, when it may be removed and placed in a tank containing a sufficient quantity of chloro-hydric acid to combine with the lime. The mixture may be gently heated, when chloride of calcium is formed, and free chromic acid. This may be again placed in the chlorine retort and heated, when a further supply of chlorine is obtained. This process may be repeated till most of the chromic acid is converted into chloride of chromium. When this takes place, which it may do after three treatings with chloro-hydric
acid, as above described, the mass containing the chloride of
472 chromium should be dissolved in water, mixed with the necessary quantity of milk of lime, until a precipitate is formed, which should be dried and heated to a cherry red, when the chlorine will be given off. The resulting mixture may be again treated as above described.

When the wood has been sufficiently acted upon by the chlorein or its compounds with oxygen, it is to be removed from the gasing chamber, and the chloro-hydric acid, with which it is saturated, which is formed by the action of the chlorine, is to be removed with water, and the wood pressed so as to remove as much of the water and acid as possible, which acid may be used to decompose

the chromate of lime in the process before described. After all the acid has been removed from the wood it is to be placed in a suitable vessel, and a weak solution of caustic alkali poured upon it, so as to cover it, when the wood falls into a pulpy mass of a dark brown or almost black color; this part of the process may be expedited by having a beater or engine working in the tank or vessel in which the alkali is placed. The alkali in this and the former process should be all saved and evaporated down by any waste heat from the boiler or retort furnaces, and reburnt, when it may again be used for the same purposes. This pulp, after being well washed, has now to be bleached; this may be done in the usual way, or we prefer to add a certain quantity of chlorite of soda, called also hypochlorite, and liberating the hypochlorous by chlorohydric acid. The quantity of chlorite of soda to be used can only be learned by experience.

Exhibit LII.

THE UNITED STATES PATENT OFFICE:

To all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the files of this office of the correspondence in the reissued letters patent granted William F. Ladd and Morris L. Keen, assignees of Charles Watt and Hugh Burgess, April 7th, 1863.

In testimony whereof, I, T. C. Theaker, Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed, this twenty-third day of October, in the year of our Lord one thousand eight hundred and sixty-six, and of the independence of the United States the ninety-first.

[SEAL.] T. C. THEAKER.

473 WASHINGTON, *March* 24, 1863.

Hon. D. P. HOLLOWAY, *Commissioner of Patents.*

SIR: In reference to your letter of this day's date, pointing out the apparent similarity of Montgolfier Freres' patent of February 7, 1838, and also Moinier Legoux' patent of March 12, 1839, to that desired to be amended by us, we would state that the processes as therein described are essentially different to that adopted by us.

In the production of paper pulp by our process we do not use any of the modes adopted by Montgolfier Freres for the production of a partial pulp previous to the alkaline treatment under pressure. Montgolfier Freres first rasp down the wood, and from the figures of the machinery it is evident that this preliminary pulping must have been very thorough. Second. They soak in lime water for some hours and then regrind, making three processes. From the following well known facts relative to the manufacture of paper, it is very evident that Montgolfier Freres did not produce a pulp adapted to the successful manufacture of paper by the action of alkaline solutions under pressure. In the production of a pulp fit for the manufacture

of paper, it is absolutely necessary that the fibre be in such state that it can felt well on the paper machine, and for this purpose it must be free from the presence of ligneous or intersticial matter, and must, in fact, be pure cellulose, in order that it may, by the operation of the rag engine, be converted into fibre capable of felting. No raw woody fibre can be converted into good paper from the impossibility of giving it the felting properties by the rag engine. We find from long experience that all vegetable substances have a definite amount of pure cellulose or fibre, and this averages from thirty to forty per cent., and consequently the loss in ligneous or intersticial matter to be about seventy to sixty per cent.

In our mode of manufacture we produce in about four hours, by the manner described in our patent, a pulp perfect in every respect for the manufacture of the best classes of paper. This pulp may at once be run into paper, or, if desired to be bleached, can be bleached with less difficulty and cost than ordinary rag pulp or half stuff.

From the following facts it is evident that Montgolfier Freres did not produce a pulp fit for the practical application of paper-
474 making by their compound process of preliminary pulping and subsequent treatment in alkaline solutions under pressure.

They state that the loss of intersticial matter is only thirty per cent., (p. 17,) or, in other words, that they get seventy per cent, fibre, a proof that pure cellulose was not obtained. They also mention that when it is desired to make a brown paper from the unbleached pulp, it is necessary to reprecipitate the resin removed by boiling by means of a metalic salt or by alum. It is obvious they had not produced a fitting fibre, but merely a disintegrated mass of impure cellulose, that required a cementing or sizing of the fibres together, and to which no action of the rag engine could impart the necessary fitting properties. A further proof that they did not produce a pure fibre is evident from the fact that they state that chloride of lime or chlorine will not bleach the pulp (p. 22) produced by their process.

It should be noticed that when Montgolfier Freres desire to bleach their pulp, they adopt such means as would produce pure cellulose or a perfect pulping, while only bleaching was the object sought. The use of chlorine and caustic alkali at the same time would, as is well known, completely disintegrate woody matter, and is used for that purpose for the production of pulp from vegetable substances. Montgolfier Freres, therefore, complete their disintegrating process by chlorine, and hence they do not find it necessary to cement the fibres together as in the unbleached pulp. From the above facts it is evident that Montgolfier Freres only used the boiling in alkaline solutions under pressure as part of their compound process. It is further evident they did not use the pressure we declare to be necessary in our patent, as they state neither chlorine or chloride of lime will bleach their pulp, though it has been subjected to alkaline solution under pressure, whereas we are able to bleach with chloride of lime at less cost than the ordinary half stuff or rag pulp.

In regard to Legoux's patent, boiling under pressure is named, but not in connection with alkaline solution. As we claim the production of a perfect pulp by the sole action of alkaline solutions under a given pressure, we do not think the compound and imperfect process described by Montgolfier Freres effects our patent. We believe we are the first who used an alkaline solution under the necessary
475 pressure to ensure the desired temperature as a sole means of producing a perfect pulp suitable to the successful manufacture of paper.

In regard to bleaching, the two processes are, we think, essentially different, in that we make use of chlorine and alkali only for the purpose of bleaching pulp from resinous woods, and moreover we use chlorine in a gaseous form, and then treat with dilute alkali, whereas, Montgolfier use the two in solution under pressure at the same time.

Yours, respectfully,

LADD & KEEN,
Per H. BURGESS.

U. S. PATENT OFFICE, *March* 24, 1862.

SIRS: In the matter of your application for reissue in two divisions of your patent for improvement in the manufacture of paper stock from wood, your attention is called to the French patent of Moinier Legoux, March 12, 1839, Brevets d'Invention, tome 52, p. 413, also the French patent of Montgolfier Freres, February 7, 1838, Brevets d'Invention, tome 67, p. 15. In these patents you will find alkaline liquids under pressure used to disintegrate wood and other substances.

The mode of bleaching is also very similar to yours. If there is any difference between your process and that of these French patents you should point it out.

Respectfully,

D. P. HOLLOWAY,
Commissioner.

Messrs. LADD & KEEN,
Care A. B. Stoughton, Esq., Washington, D. C.

Exhibit LIII.

476 THE U. STATES PATENT OFFICE:

To all persons to whom these presents shall come greeting:

This is to certify that the annexed is a true copy from the records of this office of the letters patent granted Morris L. Keen, June 16, 1863.

In testimony whereof, I, D. P. Holloway, Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed, this thirteenth day of June, in the year of our Lord one thousand eight hundred and sixty-four, and of the independence of the United States the eighty-eighth.

D. P. HOLLOWAY.

No. 38,901.

THE UNITED STATES OF AMERICA:

To all to whom these letters patent shall come:

Whereas, Morris L. Keen, of Royer's Ford, Pennsylvania, has alleged that he has invented a new and useful improved boiler for making paper pulp, which he states has not been known or used before his application, has made oath that he is a citizen of the United States; that he does verily believe that he is the original and first inventor or discoverer of the said invention, and that the same hath not, to the best of his knowledge and belief, been previously known or used; has paid into the treasury of the United States the sum of thirty-five dollars, and presented a petition to the Commissioner of Patents signifying a desire of obtaining an exclusive property in the said invention, and praying that a patent may be granted for that purpose.

These are therefore to grant, according to law, to the said Morris L. Keen, his heirs, administrators, or assigns, for the term of seventeen years from the sixteenth day of June, one thousand eight hundred and sixty-three, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said invention, a description whereof is given in the words of the said Morris L. Keen in the schedule hereunto annexed, and is made part of these presents.

In testimony whereof, I have caused these letters to be made patent and the seal of the Patent Office has been hereunto affixed.

Given under my hand, at the City of Washington, this sixteenth day of June, in the year of our Lord one thousand eight hundred and sixty-three, and of the independence of the United States of America the eighty-seventh.

[SEAL.] W. S. OTTO,
Act'g Secretary of the Interior.

Countersigned and sealed with the seal of the Patent Office.
D. P. HOLLOWAY,
Commissioner of Patents.

To all whom it may concern:

Be it known that I, Morris L. Keen, of Royer's Ford, in the county of Montgomery, and State of Pennsylvania, have invented certain new and useful improvements in boilers for making paper pulp; and I do hereby declare the following to be a full, clear and exact description of the same, reference being had to the accompanying drawings making a part of this specification, and which represents the boiler in elevation, with a portion of its upper part represented in section, to show the interior arrangement thereof.

In boilers where a perforated diaphragm is placed in the interior, and through which diaphragm the material out of which the
477 pulp is to be made is to be charged into the cylinder, it is

found that the material, falling upon the diaphragm, chokes up its openings, and, moreover, gets above or on top of the liquid, which it is the special object of the diaphragm to prevent. My object and purpose is to prevent this difficulty, and I have achieved it in a very simple manner.

My invention consists in connecting the man or feed-hole, in the shell of the boiler, with the man or feed-hole through the diaphragm, by a perforated well or cylinder, so that the material can be charged through said well into the boiler without falling upon or clogging the perforated diaphragm.

To enable othe s skilled in the art to make and use my inventicn, I will proceed to describe the same by reference to the drawings.

A represents a boiler which stands vertically in the furnace or brick-work, and which, for strength and convenience, has hemispherical ends, its body being cylindrical. This boiler is suspended to the brick-work or foundation by flanges *e*, to that it may expand and contract without loosening itself in the foundation or its support.

In the interior of the boiler, near its upper end, there is placed a perforated diaphragm B, through the centre of which there is an opening *c c*, and at the top or crown of the boiler there is also a man or feed-hole, or opening *a a*, and these two openings, *a c*, are connected by a perforated well or cylinder, G, to act as a guide for the material being charged into the boiler, and to prevent it from falling upon the perforated diaphragm, and thus not only choking its openings, but getting on top of the liquid, which it is important to avoid as damaging to the pulp.

The openings, *a c*, are respectively closed after the boiler is charged by the covers *b d*, which may be secured in any of the known ways of securing man-hole covers in steam boilers.

Above the perforated diaphragm B there is an expansion chamber I, into which the liquid contents of the boiler expand when the fire is applied to the boiler, whilst the perforated diaphragm B keeps the crude material always submerged.

E is a discharge-pipe at the bottom of the boiler A, and F a stop or discharge-valve for blowing out the contents of the boiler whilst under pressure, when said contents have been sufficiently boiled.

C is a steam-indicator, and D a safety-valve of any of the common constructions. And, instead of their being placed at the top of the boiler, they may be brought down to any convenient position or locality near the attendant, so as to be readily observed by him.

The boiler may be heated by the direct application of fire, or by any other convenient or known mode, but I prefer to use a direct application of the heat, and for this purpose use a fire-car or truck H, on wheels which to be withdrawn when the boiler is to be discharged and replaced immediately after the boiler is again refilled for service.

Having thus fully described the nature, object, and purpose of my invention, what I claim therein as new, and desire to secure by letters patent, is: First. A boiler provided with a perforated diaphragm and well, or their substantial equivalents, arranged in the manner and for the purpose described.

I also claim, in combination with the boilers, the arrangement of the discharge-pipe and valve, for the purpose of blowing out or discharging the contents of the boiler under pressure, substantially as and for for the purpose set forth.

MORRIS L. KEEN.

Witnesses:
JAMES THOMPSON.
ELIJAH SHARP.

[Here follows map, marked page 477.]

478 THE U. STATES PATENT OFFICE:

To all persons to whom these presents shall come, greeting:

This to certify that the annexed is a true copy from the records of this office of the letters patent granted Martin Nixon, May 18, 1858, No. 20,294.

In testimony whereof, I, D. P. Holloway, Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed this fourth day of December, in the year of our Lord one thousand eight hundred and sixty-two, and of the independence of the United States the eighty-seventh.

[SEAL.] D. P. HOLLOWAY.

THE UNITED STATES OF AMERICA:

To all to whom these letters patent shall come:

Whereas Martin Nixon, of Philadelphia, Pa., has alleged that he has invented new and useful improvements in preparation of fibre for paper pulp, which he states have not been known or used before his application; has made oath that he is a citizen of the United States; that he does verily believe that he is the original and first inventor or discoverer of the said improvement; and that the same have not, to the best of his knowledge and belief, been previously known or used; have paid into the treasury of the United States the sum of thirty dollars, and presented a petition to the Commissioner of Patents, signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose. These are, therefore, to grant according to law to the said Martin Nixon, his heirs, administrators, or assigns, for the term of fourteen years from the eighteenth day of May, one thousand eight hundred and fifty-eight, to the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said improvements, a description whereof is given in the words of the said Martin Nixon, in the schedule hereunto annexed, and is made part of these presents.

In testimony whereof, I have caused these letters to be made patent, and the seal of the Patent Office has been hereunto affixed. Given under my hand, at the city of Washington, this eighteenth day of May, in the year of our Lord one thousand eight hundred fifty-

eight, and of the independence of the United States of America the eighty-second.

[L. S.] JACOB THOMPSON,
Secretary of the Interior.

Countersigned and sealed with the seal of the Patent Office.

J. HOLT,
Commissioner of Patents.

Ex. N. W. H.

The schedule referred to in these letters patent and making part of the same.

To all whom it may concern:

Be it known that I, Martin Nixon, of Philadelphia, in the State of Pennsylvania, have invented a new and useful improvement in the manufacture of paper pulp from straw and like substances; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the annexed drawings, making a part of this specification.

The prominent distinguishing feature of this invention consists in a method of boiling, which involves less labor and results in a better yield of pulp in quantity and quality than is attainable by any other process known to me.

In the accompanying drawings, figs. 1, 2, and 6, exhibit in perspective various modifications of my boiling tub. Fig 3 is an axial view of fig. 1. Figs. 4 and 5 exhibit two forms of the alkalizing nozzle or nose. My process is as follows: I put whole straw in its natural state into a tub or tank *a*, provided with a perforated floor or false bottom *b*; on which the straw is supported. The space beneath the floor *b* is filled with an alkaline solution about 30 Baume in strength, and in quantity from 30 to 35 gallons to every 100 lbs. of straw. The bottom angle of the tub beneath the floor *b* is occupied by a steam-pipe *c*, perforated at intervals of about two feet with apertures about one-eighth of an inch in diameter, to permit the escape of jets of steam towards the centre of the tub *d*, is a perforated cover which rests on the mass of straw, *e* is a pipe extending axially from beneath the floor *b*, to a short distance above the cover *d*, where it may be surmounted with an inverted bowl *f*, or with a centrifugal spreader or rose *g*; but where the latter is used, the cover *d* may be dispensed with; *h* is a draw-off cock, of which there may be one or more in the bottom of each tub; *i* is a pipe discharging a current of steam into the mouth of the axial pipe *e*, which serves to impel a portion of the alkaline solution upward through said pipe and deliver it in a heated state in a continuous spreading shower upon the top of the straw (or upon the perforated cover, where one is used,) from which it percolates downward through the mass of straw; at the same time the straw, which escapes into the space beneath the floor *b*, rises through the straw. Thus there are constantly passing through the straw a descending stream of hot alkaline solution and an ascending volume of steam.

The following are among the advantages resulting from the above described method of boiling: 1st. The mass of straw is preserved in a light and porous condition, free from needless matting and bruising, enabling the deglutenizing agent to circulate freely throughout without being unduly retained in any part. The knotty portions of the straw are thus effectually reduced, so as to prevent the existence of yellow pimples and specks, which so often deface straw paper, and at the same time the extensive waste of the finer portions of the fibre incident to severe and repeated wastings and stirrings during the deglutenizing process is avoided. 2nd. The condensation of steam causes the alkaline solution to decrease in strength as the work of disintegration progresses. 3d. A vast amount of laborious and costly manipulation is avoided. 4th. The chemical agents are economized to the greatest possible extent.

For reasons above stated, it is my aim to avoid cutting or bruising the straw before the close of the alkaline treatment, preferring to keep it as nearly as possible in its natural form until the washing out of the alkalie.

The charge of straw for a tub ten feet in diameter and eight feet deep is about four thousand pounds. The deglutenizing process under ordinary circumstances occupied about twelve hours.

When the straw is cooked, I drain off the liquor, and employ it to "break down" a new batch of straw in another tub. I then run in upon the straw in the first tub a stream of cold water to wash out the alkalie, gluten, &c., and to cool the straw. I then transfer the straw into a straw or rag washer, and thence into a rag engine, or direct into the engine when it is washed thoroughly by the action of the roll and cylinder washer, until the water runs clear therefrom. I then put in about 1 lb. oil vitriol to the 100 lbs. of straw, and let it mix well with the fibre which, under the action of the roll, takes about five minutes, and then wash out. I then "let down" the roll and "open" the straw into "lint" or "fiber." The engine is then again washed down, and afterwards clear bleach liquor is drawn in from a reservoir until all the water of the engine is of proper strength to bleach, the strength used by me being $\frac{1}{4}°$ to 1° Baume, according to the grade of book, news, or writing paper, for which the stock is intended, using for fair newspaper about $\frac{1}{2}$ Baume.

From the engine the stock may be let down into bleach boxes or vats, or the washed and fibred straw may be let down into drainers, and drained, and then brought back and put into bleach liquor in the engine, and afterwards let down into bleach boxes or vats, or it may be washed and opened into fiber in the engine and let down into vats containing bleach liquor. I have operated it in different ways, but prefer the mode first described of applying the bleach liquor in the engine. The bleaching being accomplished, the stock may be worked up in the usual way for "half stuff."

Pulp made by the above process works well in any proportion with rag stock; and I make an excellent tough and white paper of straw only. I also manufactured by my process, omitting the bleach, a tough article of paper having the natural color of the straw.

I am aware that a process has existed whereby the alkaline solution is by the agency of steam heated in a separate vessel and delivered on top of the straw in intermittent showers.

This I do not claim, neither do I claim any process in which cutting of the straw is a fire-requisite; but I claim as new and of my invention:

1st. The described manner of applying the steam, whereby the solution is automatically and continuously delivered on top of the straw, as set forth.

2d. The process of boiling whole straw by the combined action of an upward current of steam and a downward current of alkaline solution permeating the mass and acting upon it in conjunction, substantially in the manner and for the purpose explained.

In testimony of which invention I hereunto set my hand.

MARTIN NIXON.

Witnesses:

GEO. H. KNIGHT.

JOS. H. GRIDLY

(Here follows map, marked page 478, No. 1.)

THE UNITED STATES PATENT OFFICE:

To all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the records of this office of the letters patent granted Morris L. Keen, Sep. 13, 1859.

In testimony whereof, I, D. P. Holloway, Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed this thirteenth day of June, in the year of our Lord one thousand eight hundred and sixty-four, and of the independence of the United States the eighty-eighth.

[SEAL.] D. P. HOLLOWAY.

THE UNITED STATES OF AMERICA:

To all to whom these letters patent shall come:

Whereas Morris L. Keen, of Royer's ford, Pennsylvania, has alleged that he has invented a new and useful improvement in boilers for making paper pulp from wood, which he states has not been known or used before his application, has made made oath that he is a citizen of the United States; that he does verily believe that he is the original and first inventor or discoverer of the said improvement; and that the same hath not, to the best of his knowledge and belief, been previously known or used; has paid into the treasury of the United States the sum of thirty dollars, and presented a petition to the Commissioner of Patents signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose.

These are, therefore, to grant, according to law, to the said Morris L. Keen, his heirs, administrators, or assigns, for the term of fourteen years from the thirteenth day of September, one thousand eight hun-

found that the material, falling upon the diaphragm, chokes up its openings, and, moreover, gets above or on top of the liquid, which it is the special object of the diaphragm to prevent. My object and purpose is to prevent this difficulty, and I have achieved it in a very simple manner.

My invention consists in connecting the man or feed-hole, in the shell of the boiler, with the man or feed-hole through the diaphragm, by a perforated well or cylinder, so that the material can be charged through said well into the boiler without falling upon or clogging the perforated diaphragm.

To enable othe s skilled in the art to make and use my invention, I will proceed to describe the same by reference to the drawings.

A represents a boiler which stands vertically in the furnace or brick-work, and which, for strength and convenience, has hemispherical ends, its body being cylindrical. This boiler is suspended to the brick-work or foundation by flanges *e*, to that it may expand and contract without loosening itself in the foundation or its support.

In the interior of the boiler, near its upper end, there is placed a perforated diaphragm B, through the centre of which there is an opening *c c*, and at the top or crown of the boiler there is also a man or feed-hole, or opening *a a*, and these two openings, *a c*, are connected by a perforated well or cylinder, G, to act as a guide for the material being charged into the boiler, and to prevent it from falling upon the perforated diaphragm, and thus not only choking its openings, but getting on top of the liquid, which it is important to avoid as damaging to the pulp.

The openings, *a c*, are respectively closed after the boiler is charged by the covers *b d*, which may be secured in any of the known ways of securing man-hole covers in steam boilers.

Above the perforated diaphragm B there is an expansion chamber I, into which the liquid contents of the boiler expand when the fire is applied to the boiler, whilst the perforated diaphragm B keeps the crude material always submerged.

E is a discharge-pipe at the bottom of the boiler A, and F a stop or discharge-valve for blowing out the contents of the boiler whilst under pressure, when said contents have been sufficiently boiled.

C is a steam-indicator, and D a safety-valve of any of the common constructions. And, instead of their being placed at the top of the boiler, they may be brought down to any convenient position or locality near the attendant, so as to be readily observed by him.

The boiler may be heated by the direct application of fire, or by any other convenient or known mode, but I prefer to use a direct application of the heat, and for this purpose use a fire-car or truck H, on wheels which to be withdrawn when the boiler is to be discharged and replaced immediately after the boiler is again refilled for service.

Having thus fully described the nature, object, and purpose of my invention, what I claim therein as new, and desire to secure by letters patent, is: First. A boiler provided with a perforated diaphragm and well, or their substantial equivalents, arranged in the manner and for the purpose described.

I also claim, in combination with the boilers, the arrangement of the discharge-pipe and valve, for the purpose of blowing out or discharging the contents of the boiler under pressure, substantially as and for for the purpose set forth.

MORRIS L. KEEN.

Witnesses:
JAMES THOMPSON.
ELIJAH SHARP.

[Here follows map, marked page 477.]

478 THE U. STATES PATENT OFFICE:

To all persons to whom these presents shall come, greeting:

This to certify that the annexed is a true copy from the records of this office of the letters patent granted Martin Nixon, May 18, 1858, No. 20,294.

In testimony whereof, I, D. P. Holloway, Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed this fourth day of December, in the year of our Lord one thousand eight hundred and sixty-two, and of the independence of the United States the eighty-seventh.

[SEAL.] D. P. HOLLOWAY.

THE UNITED STATES OF AMERICA:

To all to whom these letters patent shall come:

Whereas Martin Nixon, of Philadelphia, Pa., has alleged that he has invented new and useful improvements in preparation of fibre for paper pulp, which he states have not been known or used before his application; has made oath that he is a citizen of the United States; that he does verily believe that he is the original and first inventor or discoverer of the said improvement; and that the same have not, to the best of his knowledge and belief, been previously known or used; have paid into the treasury of the United States the sum of thirty dollars, and presented a petition to the Commissioner of Patents, signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose. These are, therefore, to grant according to law to the said Martin Nixon, his heirs, administrators, or assigns, for the term of fourteen years from the eighteenth day of May, one thousand eight hundred and fifty-eight, to the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said improvements, a description whereof is given in the words of the said Martin Nixon, in the schedule hereunto annexed, and is made part of these presents.

In testimony whereof, I have caused these letters to be made patent, and the seal of the Patent Office has been hereunto affixed. Given under my hand, at the city of Washington, this eighteenth day of May, in the year of our Lord one thousand eight hundred fifty-

eight, and of the independence of the United States of America the eighty-second.

[L. S.] JACOB THOMPSON,
Secretary of the Interior.

Countersigned and sealed with the seal of the Patent Office.

J. HOLT,
Commissioner of Patents.

Ex. N. W. H.

The schedule referred to in these letters patent and making part of the same.

To all whom it may concern:

Be it known that I, Martin Nixon, of Philadelphia, in the State of Pennsylvania, have invented a new and useful improvement in the manufacture of paper pulp from straw and like substances; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the annexed drawings, making a part of this specification.

The prominent distinguishing feature of this invention consists in a method of boiling, which involves less labor and results in a better yield of pulp in quantity and quality than is attainable by any other process known to me.

In the accompanying drawings, figs. 1, 2, and 6, exhibit in perspective various modifications of my boiling tub. Fig 3 is an axial view of fig. 1. Figs. 4 and 5 exhibit two forms of the alkalizing nozzle or nose. My process is as follows: I put whole straw in its natural state into a tub or tank *a*, provided with a perforated floor or false bottom *b*; on which the straw is supported. The space beneath the floor *b* is filled with an alkaline solution about 30 Baume in strength, and in quantity from 30 to 35 gallons to every 100 lbs. of straw. The bottom angle of the tub beneath the floor *b* is occupied by a steam-pipe *c*, perforated at intervals of about two feet with apertures about one-eighth of an inch in diameter, to permit the escape of jets of steam towards the centre of the tub *d*, is a perforated cover which rests on the mass of straw, *e* is a pipe extending axially from beneath the floor *b*, to a short distance above the cover *d*, where it may be surmounted with an inverted bowl *f*, or with a centrifugal spreader or rose *g*; but where the latter is used, the cover *d* may be dispensed with; *h* is a draw-off cock, of which there may be one or more in the bottom of each tub; *i* is a pipe discharging a current of steam into the mouth of the axial pipe *e*, which serves to impel a portion of the alkaline solution upward through said pipe and deliver it in a heated state in a continuous spreading shower upon the top of the straw (or upon the perforated cover, where one is used,) from which it percolates downward through the mass of straw; at the same time the straw, which escapes into the space beneath the floor *b*, rises through the straw. Thus there are constantly passing through the straw a descending stream of hot alkaline solution and an ascending volume of steam.

The following are among the advantages resulting from the above described method of boiling: 1st. The mass of straw is preserved in a light and porous condition, free from needless matting and bruising, enabling the deglutenizing agent to circulate freely throughout without being unduly retained in any part. The knotty portions of the straw are thus effectually reduced, so as to prevent the existence of yellow pimples and specks, which so often deface straw paper, and at the same time the extensive waste of the finer portions of the fibre incident to severe and repeated wastings and stirrings during the deglutenizing process is avoided. 2nd. The condensation of steam causes the alkaline solution to decrease in strength as the work of disintegration progresses. 3d. A vast amount of laborious and costly manipulation is avoided. 4th. The chemical agents are economized to the greatest possible extent.

For reasons above stated, it is my aim to avoid cutting or bruising the straw before the close of the alkaline treatment, preferring to keep it as nearly as possible in its natural form until the washing out of the alkalie.

The charge of straw for a tub ten feet in diameter and eight feet deep is about four thousand pounds. The deglutenizing process under ordinary circumstances occupied about twelve hours.

When the straw is cooked, I drain off the liquor, and employ it to "break down" a new batch of straw in another tub. I then run in upon the straw in the first tub a stream of cold water to wash out the alkalie, gluten, &c., and to cool the straw. I then transfer the straw into a straw or rag washer, and thence into a rag engine, or direct into the engine when it is washed thoroughly by the action of the roll and cylinder washer, until the water runs clear therefrom. I then put in about 1 lb. oil vitriol to the 100 lbs. of straw, and let it mix well with the fibre which, under the action of the roll, takes about five minutes, and then wash out. I then "let down" the roll and "open" the straw into "lint" or "fiber." The engine is then again washed down, and afterwards clear bleach liquor is drawn in from a reservoir until all the water of the engine is of proper strength to bleach, the strength used by me being $\frac{1}{4}°$ to 1° Baume, according to the grade of book, news, or writing paper, for which the stock is intended, using for fair newspaper about $\frac{1}{2}$ Baume.

From the engine the stock may be let down into bleach boxes or vats, or the washed and fibred straw may be let down into drainers, and drained, and then brought back and put into bleach liquor in the engine, and afterwards let down into bleach boxes or vats, or it may be washed and opened into fiber in the engine and let down into vats containing bleach liquor. I have operated it in different ways, but prefer the mode first described of applying the bleach liquor in the engine. The bleaching being accomplished, the stock may be worked up in the usual way for "half stuff."

Pulp made by the above process works well in any proportion with rag stock; and I make an excellent tough and white paper of straw only. I also manufactured by my process, omitting the bleach, a tough article of paper having the natural color of the straw.

I am aware that a process has existed whereby the alkaline solution is by the agency of steam heated in a separate vessel and delivered on top of the straw in intermittent showers.

This I do not claim, neither do I claim any process in which cutting of the straw is a fire-requisite; but I claim as new and of my invention:

1st. The described manner of applying the steam, whereby the solution is automatically and continuously delivered on top of the straw, as set forth.

2d. The process of boiling whole straw by the combined action of an upward current of steam and a downward current of alkaline solution permeating the mass and acting upon it in conjunction, substantially in the manner and for the purpose explained.

In testimony of which invention I hereunto set my hand.

MARTIN NIXON.

Witnesses:

GEO. H. KNIGHT.

JOS. H. GRIDLY

(Here follows map, marked page 478, No. 1.)

THE UNITED STATES PATENT OFFICE:

To all persons to whom these presents shall come, greeting:

This is to certify that the annexed is a true copy from the records of this office of the letters patent granted Morris L. Keen, Sep. 13, 1859.

In testimony whereof, I, D. P. Holloway, Commissioner of Patents, have caused the seal of the Patent Office to be hereunto affixed this thirteenth day of June, in the year of our Lord one thousand eight hundred and sixty-four, and of the independence of the United States the eighty-eighth.

[SEAL.] D. P. HOLLOWAY.

THE UNITED STATES OF AMERICA:

To all to whom these letters patent shall come:

Whereas Morris L. Keen, of Royer's ford, Pennsylvania, has alleged that he has invented a new and useful improvement in boilers for making paper pulp from wood, which he states has not been known or used before his application, has made made oath that he is a citizen of the United States; that he does verily believe that he is the original and first inventor or discoverer of the said improvement; and that the same hath not, to the best of his knowledge and belief, been previously known or used; has paid into the treasury of the United States the sum of thirty dollars, and presented a petition to the Commissioner of Patents signifying a desire of obtaining an exclusive property in the said improvement, and praying that a patent may be granted for that purpose.

These are, therefore, to grant, according to law, to the said Morris L. Keen, his heirs, administrators, or assigns, for the term of fourteen years from the thirteenth day of September, one thousand eight hun-

dred and fifty-nine, the full and exclusive right and liberty of making, constructing, using, and vending to others to be used, the said improvement, a description whereof is given in the words of the said Morris L. Keen in the schedule hereunto annexed and is made a part of these presents.

In testimony whereof, I have caused these letters to be made patent, and the seal of the Patent Office has been hereunto affixed Given under my hand, at the city of Washington, this thirteenth day of September, in the year of our Lord one thousand eight hundred and fifty-nine, and of the independence of the United States of America the eighty-fourth.

[L. S.] JACOB THOMPSON,
Sec. of the Interior.

Countersigned and sealed with the seal of the Patent Office.
S. T. SHUGERT,
Act'ng Com. of Patents.

The schedule referred to in these letters patent and making a part of the same.

To all whom it may concern:

Be it known that I, Morris L. Keen, of Royer's Ford, in the county of Montgomery, and State of Pennsylvania, have invented certain new and useful improvements in boilers for boiling wood and ligneous materials for making paper pulp, under pressure; and I do hereby declare that the following is a full, clear, and exact description of the construction and operation of the same, reference being had to the accompanying drawings, in which fig. 1 represents a perspective view of said boiler. Fig. 2 represents a vertical central section through the same.

My invention relates to the construction of a boiler for boiling wood and ligneous materials for making paper pulp, in which proper provision is made for keeping the stock covered by the alkali or liquid used, and giving it motion to insure the mass being properly boiled throughout, and a discharge valve or cock, by means of which the stock, when sufficiently boiled, is blown out in a pulpy state.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation.

A represents a vertical cylindrical boiler, which is mounted on supports B, or on any other suitable frame. The upper part of the boiler is made conical, and is provided with an expansion chamber C through the aperture of which the boiler is charged, and which is closed by a cover D, which is bolted steam tight to the same. The bottom of the boiler A is made funnel shaped, and ends in the centre in the discharge pipe E, which is closed by a piston or stop-cock G; the latter is secured to the rod H, and can be opened or closed by means of the hand-wheel F, of the rod H, which passes through the stuffing-box I, and has its lower bearing in the bracket a; K represents its two stirrers, the shafts of which run at their lower ends in the

stops b, while their upper ends pass through the stuffing-boxes I and are provided with pinions M, which are driven by suitable gearing. The shafts of the stirrers K are provided on one side only with the horizontal stirring arms, which, when the boiler is to be charged, are turned towards the periphery of the boiler, and are therefore not in the way of the material as it is thrown into the boiler; d represents a perforated plate, which is secured to the rod N, and which rests on the brackets q of the expansion chamber C, it is intended to press the material down and to keep it submerged in the fluid in which it is to be boiled; the plate d is prevented from rising by the upper end of the rod n being in contact with the lower face of the cover D; O represents try-cocks, by which the material in the boiler can be tried, to what degree of perfection the stock is worked. The operation is as follows:

The boiler being charged with the proper solution of caustic alkali, or other suitable fluid, and with the material which is to be reduced to pulp, the plate d is placed upon it, and the cover D is screwed down tightly; the boiler A is then heated, either by a direct fire or by any other heating apparatus, and the mass in the boiler is boiled and stirred until thoroughly disintegrated; during this process the steam arising from the fluid rises through the perforated plate d, and and fills the expansion chamber C, whence it exerts a pressure upon the boiling mass in the boiler. When the stock has been reduced to the desired perfection the stop-cock G is opened by means of the hand-wheel F, and the entire mass is blown by the pressure of the steam in the expansion chamber and boiler through the pipe E as a pulp into an open tank adjacent to the boiler A. The expansion chamber C may be provided with a pipe leading to a steam guage to indicate the pressure of steam in the boiler.

Having thus described my invention, what I claim is, a boiler for boiling, under pressure, wood and ligneous materials for making paper pulp, constructed with an expansion chamber, stirrers and discharge valve or cock, arranged for the purposes and in the manner substantially as herein stated.

MORRIS L. KEEN.

Witnesses:
EPHRAIM MILLER.
HUGH BURGESS.
Ex'd. A. T.

(Here follows map, marked page 478, No. 2.)

479 THE AMERICAN PAPER COMPANY
v.
JACOB D. HEFT, S. A. RUDOLPH, and John W. Dixon.

In order that the degree of pressure used in the defendants' boilers or digestors for cooking wood and straw in the manufacture of paper pulp, may be accurately tested and acertained at all stages of the process, and to save time in examining laborers and other witnesses

upon the subject, the complainants propose that Philip S. Justice or some other competent and disinterested engineer in steam machinery be admitted to the defendants factory, and make such experiments as will enable him to make a report satisfactory to himself, as to such degree or degrees of pressure at each and every stage of said pulping process as now and have been hitherto in daily use in the defendants factory.

Phila., Sept. 27, 1866,

T. A. JENCKES,
H. E. WALLACE,
For Complainants.

To GEORGE HARDING, Esq., *Sol. for Deft's.*

Circuit Court, United States, for the eastern district of Penna

AMERICAN WOOD PAPER CO.,
versus
JACOB D. HEFT *et al.*

In reply to your communication I propose that we agree that the case shall be heard before the first day of December next, that the taking of testimony be continued from day to day until closed, with reasonable adjournments.

That James F. Neall, a party named by Philip S. Justice, be appointed to inspect the defendent's apparatus.

That he witness the following operations, viz:

1st. The cooking of a batch of wood at the defendants' usual pressures and under the usual conditions.

That he test the safety-valve and gauge and record the pressures during the operation.

That he bring away specimens of the raw pulp, the washed pulp, the bleached pulp, the refuse liquor, the liquor used upon the wood, the liquor used upon the straw.

That he witness the cooking of a batch of straw at the defendants' usual pressure and conditions, and report in like manner on the same, and bring away specimens thereof: Raw, washed, and bleached.

That Mr. Neall be accompanied by Dr. Muckle on behalf of the plaintiff, and Professor Garrett on behalf of the defendants.

That said parties report as promptly as possible, and that said report be sworn to and used as evidence in the cause.

Yours truly,
GEORGE HARDING.

The above proposition is accepted.
T. A. JENKS, *For Complainant.*

480 In the matter of the controversy between the American Wood Paper Company and Jacob D. Heft, John W. Dixon, and S. A. Rudolph, the undersigned committee, appointed by the mutual agreement of the above parties, respectfully report that in

pursuance of the agreement they visited the paper works of Jacob D. Heft and Company, opposite Manayunk, in Montgomery county, Pennsylvania, on Saturday, September 29, 1866, and witnessed an entire operation of boiling a batch of wood, (poplar.)

The operation was conducted by the workmen of the mill, the proprietors being absent excepting S. A. Rudolph, and he taking no part in it whatever. Hugh Enos was the foreman of the pulp department, and, in the absence of the proprietors, had full charge, and the instructions of the committee to him were to conduct the operation as usual.

The committee first examined the "boiler" or digester and found it to be of wrought iron, cylindrical in form, and placed upright. The interior wrs paovided with two diaphragms, one being placed near the top and the other near the bottom, a man-hole on the top for the introduction of the wood, and a side-valve at or near the bottom through which the pulpified wood in finally discharged. A coil of wrought iron pipe, heated in a furnace, at some distance from the boiler, communicates with the latter by two pipes, one of which is connected with the bottom, and the other with the top. In the lower pipe, intermediate between the bottom of the boiler and the coil, is a rotary pump, by means of which the liquor is drawn from the bottom of the boiler and forced through the hot coil and the pipe into the top of the boiler, thereby producing a regular circulation of the liquor employed.

The safety-valve was found to be one of the kind generally used, constructed as follows, viz: cast iron casing and cap, brass valve and valve seat, with a wrought iron lever, and cast iron weight. The lever was graduated from 30 to 100 pounds pressure per square inch, each graduation being indicated by a notch in the top edge and stamped on the side with figures showing the amount of pressure each notch represented. The only notch exhibiting the wear of use was that marked for 60 pounds.

The committee then examined and tested the gauges. The regular gauge used at the works is a spring gauge, made by E. H. Ashcroft, Boston, Mass., No. 938, registering from 0 to 200 pounds. There was also used in the examination one of the Shaw & Justice
481 mercury column gauges, No. 1,904, made in Philadelphia. This registered from 35 to 425 pounds. Both of these gauges were tested by a standard mercury column gauge, Shaw & Justice patent, No. 1,853. The apparatus employed for this purpose was a hydraulic test pump. The results will be found appended marked Exhibit A.

After the gauges were satisfactorily tested they were attached to the boiler, the spring gauge occupying its usual position, being connected with a pipe leading from the bottom of the boiler, and the mercury gauge used in the examination was placed beside it, having a communication in common with the former.

In the course of the operation hereafter to be described, the committee tested the safety-valve by steam pressure as indicated by the two gauges, believing it to be the most correct method, and found it

relieving the pressure in the boiler at 50 pounds pressure as indicated on the spring gauge, and 52⅓ pounds as indicated on the mercury gauge, with the weight on the 50 pounds graduation on the lever; and when the steam escaped at the valve with the weight placed on the 60 pounds notch, the spring gauge marked 57 pounds and the mercury gauge 58 pounds. With the weight still placed on the 60 pounds graduation on the lever, and the gauges registering 59 pounds, (spring gauge,) and 60 pounds, (mercury gauge,) the pressure was relieved very freely.

The "boiler" or digester upon being examined was found to be entirely empty. It was then filled in the usual manner, viz: by first packing the side-valve with pulp to make it tight, then by placing some cut straw upon the diaphragm, and filling up with the chipped wood. The alkali solution was then introduced in sufficient quantity to cover completely the contents. The filling of the boiler with this solution required from 10 a. m. until 11.50 a. m. The quantity introduced we could not ascertain. The circulation of liquor was started in the coil by the pump, the man-hole was closed and the "cooking" commenced. The cooking was finished at 9.18 p. m., when the fire under the coil was withdrawn, and at 9.35 p. m. all communication with it cut off. At 10.28 the gauge cocks were closed, and the liquor turned into a tank to be re-used on straw, and the pulp was dumped at 11.4 p. m.

Being desirous of testing the alkaline liquors the committee collected samples for that purpose. The instruments used were a thermometer (Fahrenheit) and two hydrometers (Beaumé.) The 482 hydrometer belonging to and used at the works was also tested.

All the hydrometers were designed to ascertain densities greater than that of water. These were compared by the committee with standard instruments; the comparison of thermometers being appended and marked Exhibit B 1, that of the hydrometers marked Exhibit B 2.

The strength of the alkali solution was tested from time to time (after being cooled) as it passed into the boiler. Eight such samples were taken and the results are hereunto appended and marked Exhibit C 1. To confirm the determinations the eight samples were mixed, and again tested. The result obtained in given in Exhibit C 2. The liquor ejected from the coil into the top of the boiler after having passed once through the wood was tested and the result appended marked Exhibit C 3. The strength of the liquor from the wood after the boiling was completed as given in Exhibit C 4.

During the operation of "cooking" the guages were watched and noted. The time of observation and the corresponding pressures indicated by them are appended marked Exhibit D. The register-in of the mercury gauge being from 35 pounds upwards, no reading could be taken at a less pressure. The pressure at which the boiler was "dumped" could not be ascertained, since communication betwhen the boiler and gauges was cut off to prevent the gauge pipe from filling up with pulp.

Exhibit A.

Standard.	Mercury.	Spring.
40	..	42.5
50—	50	50
60	60	..
60*	..	60
72.5	..	70
75	75	..
100	100	..
105*	..	100

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Exhibit B 1.

Standard.	Used.
60	59.5
100	99¾
120	119.5

Exhibit B 2.

	Standard.	Used.		
		No. 1.	No. 2.	Words.
Water at 60°—70° (Fahrenheit,)	0°	0°	0°	2°
Alkali solution at 70° (Fahrenheit,)	12°	12°—	12°*	14°—
" " " "	12°	11¾°	12°	

Exhibit C 1.

Sample.	Temperature. (Fahrenheit.)	Hydrometers. No. 1.	Hydrometers. No. 2.	Remarks.
No. 1	90°	4—	4—	first
Cooled to	70	3¾	4	introduced.
No. 2	70	12—	12*	
" 3	72–73	12—	12	
" 4	72	12	12*	
" 5	73	12—	12	
" 6	68	12*	12*	
" 7	70	12	12*	last
" 8	71	12*	12*	introduced.

Exhibit C 2.

Temperature.	Hydrometers.	
71	10½	11

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Exhibit C 3.

Temberature.	Hydrometers.	
72	11¼	12½

Exhibit C 4.

Temperature.	Hydrometers.	
70	$13\frac{3}{4}$	$14\frac{1}{4}$

Exhibit D.

Time.	Pressure. Spring.	Pressure. Mercury.	Remarks.
1.20 P. M.	6—		
1.23 "	$7\frac{1}{2}$		
1.40 "	$7\frac{1}{2}$		After this it rose to eight, then diminished and finally ceased to indicate. Guage removed and the tube cleared.
2.22 "	47.5	48	
2.25 "	50	52.5	Steam blowing off at safety-valve with 50 lbs. weight.
2.27 "	54	55	
2.28 "	52.5	53	
2.32 "	45	45	
2.35 "	42.5	42.5	
2.46 "	42.5	42.5	
2.49 "	49	45	
2.58 "	50	50—	
3.01 "	55	57.5	
3.05 "	52.5	53	Mercury thrown up irregularly against side of tube.
3.07 "	55	57	
3.09 "	57.5	59	
3.18 "	55	57	
3.23 "	53	55	
3.25 "	55*	56—	
3.30 "	59	60	Steam blowing off at safety-valve.
3.35 "	56	57	
3.40 "	58	59	
3.45 "	58	59	
3.50 "	57	58	
3.55 "	57.5	58.5	
4.00 "	57.5	58.5	
4.05 "	57.5	58.5	
4.10 "	57.5	58.5	
4.15 "	57.5	58.5	
4.20 "	57.5	58.5	
4.30 "	59	60	
4.40 "	57.5	58.5	
4.50 "	57.5	59	
5.00 "	57.5	59	
5.05 "	57	58	
5.10 "	57	58	
5.15 "	57	58	
5.20 "	56.5	57.4	

5.25	P. M.	56.5	57.5
5.30	"	56	57
5.35	"	56	57
5.40	"	56	57
5.45	"	55.5	56.5
5.50	"	57	58
5.55	"	56.5	57.5
6.00	"	56.5	57.5
6.05	"	56	57.5
6.15	"	57.5	58.5
6.20	"	57	58
6.25	"	57	58
5.30	"	57	58
6.35	"	56.5	57.5
6.40	"	56.5	57.5
6.45	"	57	58
6.50	"	57	58
6.55	"	57	58
7.00	"	57.5	59
7.05	"	57	58
7.10	"	57.5	58.5
7.15	"	57.5	58.5
7.20	"	57.5	58.5
7.25	"	57.5	58.5
7.30	"	57	58
7.35	"	56	57
7.40	"	57	58
7.45	"	57	58
7.50	"	57	57.5
7.55	"	57.5	58.5
8.00	"	56.5	57.5
8.05	"	56.5	57.5
8.10	"	55.5	56.5
8.15	"	55.5	57
8.20	"	56—	57
8.25	"	55.5	57—
8.30	"	55.5	56.5
8.35	"	57*	58
5.40	"	57*	58
8.45	"	56	57
9.50	"	55.5*	57
8.55	"	55.5	56.5
9.00	"	55.5—	56*
9.18	"	52.5	53.5
9.30	"	51	51
9.40	"	50	50
10.06	"	47	47
10.28	"	45	44
19.40	"	42.5	41.5
10.50	"	40	39

The committee again visited the works of Jacob D. Heft & Co. on Monday, October 1, 1866, and witnessed the operation of
487 "cooking" a batch of straw. It was conducted by the same workmen who were engaged on the Saturday preceeding. The proprietors were absent as before, except S. A. Randolph, and he taking no part in it whatever.

The boiler employed was similar to the one used in making the wood pulp of Saturday, September 29, and the coil for heating was the same as that used for the wood boiler, it being so arranged as to communicate with the one or the other, as desired. The only alteration made in the apparatus was the change in the position of the spring guage. The guage was placed on the top of the boiler in order to determine if there was any difference in the pressures between the top and bottom. The mercury guage was retained in its original place. This was done at the request of one of the committee. A decided difference was observed between the readings of the two guages. The indications of the lower (mercury) guage being higher than those of the upper (spring) guage. This no doubt was caused by hydrostatic pressure operating upon the guage attached to the bottom of the boiler. The guage on top of the boiler being free from hydrostatic pressure would, therefore, indicate the correct steam pressure during the operation.

The boiler was examined and found to be empty, the slide-valve was packed with pulp as in Saturday's operation, the boiler was filled with cut straw, and fresh alkali solution together with liquor from the "re-use" tank was introduced at 12.30 p. m. The latter was the partly expended liquor drawn from the pulpified wood previously mentioned. The liquor was then started through the coil at 2.15 p. m. Samples of these liquors were collected, cooled, and tested. The results of the fresh solution (alkali) are appended, marked Exhibit E 1; that of the liquor from the "reuse" tank, marked Exhibit E 2; and that of the mixed liquors, after passing once through the straw, marked Exhibit E 3.

The man-hole being closed at 2.19 p. m., the cooking commenced and the registering at the guages noted. The time and corresponding pressures will be found appended, marked Exhibit E.

The fire was "drawn" at 8.35 p. m., and connected with the coil cut off at 8.45 p. m. Steam blew from the safety-valve at 10.35 p. m., and the contents of the boiler were dumped at 10.58 p. m., at 18 pounds pressure as indicated on the spring gauge.

The committee did not witness the operation of bleaching
488 the pulp obtained either from the wood or straw, and could not ascertain the quantity used for a batch of either material. Two samples were collected and tested and the result is hereunto appended, marked Exhibit G.

The committee also collected samples as follows:

A sample of the raw wood pulp, marked exhibit H 1.

A sample of the same, hand-washed, marked exhibit H 2.

A sample of the wood pulp bleached by one of the committee with some of the "bleach" of the works, marked exhibit H 3.

A sample of the raw straw pulp, marked exhibit H 4.

A sample of hand-washed straw pulp, marked exhibit H 5.

Samples of these two pulps were brought from the works by Hugh Enos, and given by him into the hands of the committee.

The sample of the washed wood pulp is marked exhibit A C S.

The sample of the same wood pulp, bleached at the works, is marked exhibit B, C, S.

The sample of the washed straw pulp is marked exhibit C C S.

The sample of the same straw pulp, bleached at the works, is marked exhibit D, C, S.

All of these are herewith respectfully presented, with the sworn affidavit of Hugh Enos, marked exhibit I, accompanying. In conclusion, the undersigned would state that every facility was afforded them for making the observations.

(Omission.) A sample of bleached straw pulp, (bleached by one of the committee,) accompanies the other specimens, marked exhibit H 6.

JAMES F. NEALL,
ALEX'R MUCKLE.
THOS. H. GARRET.

On this tenth day of October, 1865, personally appeared before me Charles Sergeant, United States Commissioner, the above-named James F. Neal, Alexandre Muckle, and Thomas H. Garret, who, being by me severally sworn, did depose and say that the facts set forth in the foregoing report are true.

CHARLES SERGEANT,
U. S. Commissioner.

489 *Exhibit E* 1.

Sample.	Temperature. (Fahrenheit.)	Strength (Beaume.) Hydrometer. No. 1.	No. 2.	Remarks.
No. 1	70	4	4¼	Collected at the beginning of filling.
No. 2	75	5	4	The hydrometer belonging to the works marked 6°.
No. 3	75	3¾	4	
No. 4	76	3½	3¾	
No. 5	76	3¼	3½	
No. 6	78	3	3¼	Collected at the end of filing.

Exhibit F 2.

Sample.	Temperature.	Strength (Beaume.) Hydrometer. No. 1	No. 2.	Remarks.
No. 1	76	14	14¾	Taken out of the tank.
No. 2	76	14	14¾	Collected while passing into boiler.

Exhibit F 3.

Temperature.	Hydrometer.	Strength, (Beaumé) No. 1.	No. 2.
76		$6\frac{3}{4}$	7

490

Exhibit F.

Time.	Pressure. Spring.	Mercury.	Remarks.
3.48 P. M.	7.5		These pressures were not indicated on the mercury gauge.
3.49 "	10		
3.55 "	10		
4.02 "	13		
4.05 "	11		
4.10 "	18		
4.12 "	25		
4.15 "	32.5		
4.20 "	18.5		
4.25 "	20		
4.30 "	34		
4.36 "	25.5		
4.40 "	23.5		
4.45 "	23.5		
4.50 "	29		
4.53 "		44	
4.55 "	37	37.5	
4.58 "	30		
5 "	32	35	
5.05 "	35	35	
5.10 "	34	36×	
5.15 "	44	48×	
5.20 "	35.5	41.5	
5.25 "	35.5	40	
5.30 "	48	51.5	
5.35 "	39	46.5	
5.40 "	44	37.5	
5.45 "	34.5	36.5	
5.50 "	38	42	
5.55 "	42	45.5	
6 "	43.5	46	
6.05 "	45.5	51.5	
6.10 "	44.5	47	
6.15 "	47.5	51	
6.20 "	46.5	51	
6.25 "	43	47	
491 6.30 P. M.	47.5	55	
6.35 "		43—	46·5
6.40 P. M.	44	48.5	

6-45 P. M.		43	46.5
6.50	"	43+	47
6.55	"	45.5	49.5
7.00	"	50—	48
7.05	"	47	53
7.10	"	45—	48
7.15	"	50	52.5
7.20	"	46	52
7.25	"	50.5	54
7.30	"	48	52.5
7.35	"	46	50
7.40	"	46—	50
7.45	"	46	57
7.50	"	47	52
7.55	"	47	50
8.00	"	46	49+
8.05	"	46	50
8.10	"	46	50
8.15	"	45+	48.5+
8.20	"	45	50
8.25	"	49	54
8.30	"	47	51
8.35	"	47	51+ Fire drawn from under coil.
8.40	"	47.5	51.5+
8.45	"	49	51+ Cocks turned off, boiling finished.
8.50	"	47	50.5
8.55	"	46	50
9.00	"	35	49+
9.15	"		46
9.30	"		44
9.45	"		42
10.00	"		40
10.20	"		37.5
10.35	"	34	34
10.58	"	18	Boiler dumped.

492 AMERICAN WOOD PAPER CO. *vs.* J. D. HEFT *et al.*

Hugh Ennis, being duly sworn, doth depose and say that the specimen of pulp marked A, C. S. is the wood pulp which was dumped from the boiler in the presence of Messrs. Muckle, Garret & Neal, on Saturday night, September 29, the same having been merely washed in the engine in the regular way. The specimen marked B. C. S. is the same pulp bleached in the regular way as pursued at our mill. The specimen marked C. C. S. is straw which was dumped on Monday night, October 1, 1866, in the presence of the committee of gentlemen named above, the same having been merely washed in the engine washed in the regular way.

Specimen marked D. C. S. is the same pulp bleached in the regular way as pursued at our mill.

This deponent further says, that the boiler of wood cooked on Saturday last was cooked in the usual way pursued by this deponent and his assistants at S. D. Heft & Co.'s mills since he has been in their employ, about one year in last August. That the boiler of straw cooked on Monday, in the presence of the committee, was cooked in the usual way which has been practised at this mill during the time that he has been in their employ.

The deponent has been foreman of the boiler department at J. D. Heft & Co., ever since they commenced to work on wood and straw, and has had exclusive charge of this department.

HUGH ENNIS.

Sworn to and subscribed before me this 2d day of October, 1866.

CHARLES SERGEANT,
U. S. Commissioner.

In the Circuit Court of the United States, eastern district of Pennsylvania.

AMERICAN WOOD PAPER COMPANY
vs.
JACOB D. HEFT *et al.*

Depositions of sundry witnesses before me, Charles Sergeant, United States commissioner, and special examiner appointed by the court in above case, taken and reduced to writing by me at my office, No. 125 South 5th st., West Philadelphia, on the eleventh day of May, 1867, and from time to time as adjourned, and adjournments noted, to be read in evidence on behalf of defendants, on the hearing of above case, the said witnesses having been first carefully examined, cautioned, and sworn to testify the truth, the whole truth, and nothing but the truth.

MAY 11, 1867.

Parties present: H. E. Wallace, for plaintiffs; and George Harding, for defendants.

Mr. Harding gives in evidence, on behalf of defendants, the following certified records of the United States Patent office:

Certified copy of letters patent of Charles Watt, Hugh Burgess, July 18th, 1854, marked Exhibit (XLII) C. S., U. S. comm'r.

(Objected to.)

Certified copy of correspondence, and filed in matter of application of Watts & Burgess, for letters patent of July 18, 1854, marked—

In the Circuit Court of the United States, eastern district of Penn'a.

AMERICAN WOOD PAPER CO.
vs.
JACOB D. HEFT *et al.*
} In equity.

SIR: Please to take notice that depositions in the above case, on behalf of defendants, will be taken before Charles Sergeant, U. S. comm. and examiner, on May 11, 1867, at 10 a. m., and to continued from day to day until completed, between the hours of 10 a. m. and 6 p. m.

May 3, 1867.

GEO. HARDING,
Sol'r for Def'ts.

H. E. WALLACE, *Sol'r for Defendants.*

Accepted May 4, 1867.

H. E. WALLACE.

Exhibit XLVIII, C. S., U. S. comm'r.
(Objected to.)
Certified copy of application and correspondence in the matter of the re-issued letters patent issued to Ladd and Keen October 5, 1858, marked Exhibit XLIX, C. S. U. S. comm'r.
(Objected to.)
Certified copy of letters patent issued to Watt & Burgess, October 5, 1858, marked Exhibit L, C. S., U. S. comm'r.
Objected to.)
Certified copies of files and record in matter of application for re-issue of letters patent to Ladd & Keen, April 7, 1863, marked Exhibit XII, C. S., U. S. comm'r.
(Objected to.)
Certified copy of files, wrapper and correspondence, in matter of letters patent to Morris L. Keen, June 16, 1863, marked Exhibit LIII, C. S., U. S. Comm'r.
(Objected to.)
Also, traitee de chimie applique aux arts Par M. Dumas.
Objected to.)
June sixime, A. Paris, 1843.
Pp. 16, 17. Articles 3,381, marked Exhibit LIV, C. S., U. S. comm'r, as follows:
(Objected to.)
Letters patent of Martin Nixon, May 1868, Exhibit LV.
(Objected to.)
By agreement of counsel adjourned to May 15, 1867.

Exhibit G.

Sample.	Temperature Fahrenheit.	Strength. Hyd. No. 1.	Beaume. No. 2.
No. 1,	70°	2.6	3
No. 2,	70°	$3\frac{1}{2}$	$3\frac{3}{4}$

Pursuant to adjournment, May 11th, 1867, the parties met May 15th, 1867; present, Messrs. Harding and Wallace.

1 Q. "What is your name, age, residence, and occupation?"

A. "My name is Hiram Stanhope; I am a little over fifty-two years of age; I reside at Aramingo, Philadelphia; I am a machinist and boiler maker; am a member of the firm of Stanhope & Supplee."

493 2. "Please examine the drawing of a boiler annexed to the bill of complaint in this suit, marked Exhibit M, being the drawing of the patent (No. 38,901,) dated June 16th, 1863, a tracing whereof is hereunto annexed, marked "Tracing of Patent, No. 38,901," and state whether your firm constructed any boilers like that; and if so, how many, and when and for whom?"

A. "This is a tracing of the boiler such as we made; we constructed four; the order for them was given April 20th, 1859; two were delivered June 1st, 1359, and two June 28th, 1859; they were built for J. & D. George; they were charged on our books to them; I know they were paid for."

3. Q. "Who furnished you the drawings to build them by?"

A. "Morris L. Keen."

4. Q. "Were there boilers put to work? and if so, how soon? and have you ever seen them in operation, and where?"

A. They were put to work as soon as they could be put up, after they were delivered; I have seen them in operation at Royer's Ford, at the paper mill of J. & D. George; the boilers were put in operation within three weeks after they were delivered, just so soon as they could be put up."

1*. Q. "Do you speak of this from recollection entirely, as respects dates, order and delivery?"

A. "That is taken from our books."

2*. "Had you a contract with anybody for the erection of these boilers?"

A. "I cannot say whether there was a written contract or not."

Mr. Wallace requested witness to produce a transcript from his books.

Witness resumed: "The order was given by Mr. Keen."

3*. "Did you manufacture and deliver the boiler with all the appurtenances and fixtures, as described in this patent, or did you merely deliver the shell?"

A. "We furnished all except the steam-gauge here represented; we furnished these perforated screens, and the pipe and stop-valve, marked F, at the bottom; we furnished the parts marked D and G."

4*. Q. "Did you set it up and put it in operation yourself?"

A. "No, sir."

5*. Q. "Were you furnished with drawings of each of the separate parts?"

494 A. "Yes, sir; we were furnished with drawings of the stop-valves; that is, I was furnished with a sketch of them, from which I made drawings. The sketch of the screen was furnished to us as it is in this boiler."

6*. Q. "When you delivered it was it furnished in parts or the whole?"

A. "When we delivered it the upper screens were fitted in the boiler before it left the shop, and the lower pipe with the stop-valve was riveted at the bottom after the boiler was set up in its place."

7*. Q. "When you say that it was put in operation, what do you mean by that expression?"

A. "When they were charged with wood and heated up, and then blowed off after the wood was cooked, as they call it, it was blowed off into what they call a blow-tank."

8* "Was that the first time the boiler was used?"

A. "I did not see it the first time, but have seen it very often in operation."

9*. Q. "How long after the delivery was the first time you saw it in operation?"

A. "I do not recollect; it might have been a month, or two months."

10*. Q. "Are you sure it was in that year, 1859?"

A. "Yes, sir."

11*. Q. "Then you were requested, as an artisan in work of this kind, to make this boiler by Mr. Keen after plans submitted by him?"

A. "Yes, sir; Keen requested me to make it, but I think the Georges paid for it. I furnish you a copy of the entries in my book marked entries C. S."

12*. Q. "Did you ever make any for any one else similar to this?"

A. "No, sir."

HIRAM STANHOPE.

Sworn and subscribed before me this fifteenth day of May, A. D. 1867.

CHAS. SERGEANT, *U S. Com'r.*

Adjourned to May 18th, at 10 o'clock, a. m.

Entries C. S.

The order was given April 20th, 1859, verbally, by Morris L. Keen for J. & D. George, and reads:

495 "J. & D. George wants four boilers, sixteen feet long, fifty-four inches diameter, double riveted, made of three-eighths iron."

Two boilers delivered June 21st, and two June 28th, 1859.

Paid for by notes drawn by Jesse George in favor of J. & D. George.

Notes received August 17th and 31st, 1859, at three months.

In the Circuit Court of the United States for the eastern district of Pennsylvania.

Testimony for defendants.

AMERICAN WOOD PAPER COMPANY, plaintiffs,
vs.
JACOB D. HEFT AND OTHERS, defendants.

UNITED STATES OF AMERICA,
District of Columbia, County of Washington, ss:

Be it remembered, that on this seventeenth day of May, in the year of our Lord one thousand eight hundred and sixty-seven, I, Edmund F. Brown, "a commissioner of the United States for the District of Columbia, under all the several acts of Congress providing for and authorizing the appointment of commissioners, and prescribing the powers and duties of the same," duly appointed by the Supreme Court of the District of Columbia, did call and cause to be and personally appear before me at my office, No. 402 F street, north, in the city of Washington, in the said district, Cornelius Jacobs, to testify and the truth to say on the part and behalf of the defendants, in a certain suit or matter of controversy now depending and undetermined in the Circuit Court of the United States for the eastern district of Pennsylvania, wherein the American Wood-Paper Company are plaintiffs, and Jacob D. Heft and others are defendants.

And the said Cornelius Jacobs, being about the age of forty-nine years, and having been by me first cautioned and sworn to testify the truth, the whole truth, and nothing but the truth, in the matter of controversy aforesaid, I did carefully examine the said Cornelius Jacobs, and he did thereupon depose, testify, and say as follows, in answer to interrogatories by George Harding, esq., counsel for the defendants:

1. Q. "Have you charge of the models and specimens deposited in the the United States Patent Office? and if so, how long have you had charge of them?"

496 A. "I have, and have had charge of them since the fall of 1855."

2. Q. "Have you, with the consent of the Commissioner of Patents, placed in sealed bottles a small portion of the specimens on file in the Patent Office, bearing the labels as follows:

"'Charles Watt, London, and Hugh Burgess, of the city of London, England; improvement in the manufacture of paper from wood; patented July 18, 1854; patented in England August 19, 1853. Ladd & Keen, New York, N. Y., and Philadelphia, Pa., assignees of Watt & Burgess; improvement in the manufacture of paper from wood; patented July 18, 1854; ante-dated August 19, 1853; reissued October 5, 1858.'

"'Ladd & Keen, of New York, N. Y., and Philadelphia, Pa., assignees of Watt & Burgess, of London, England; improvement pulp from wood, etc., for the manufacture of paper; patented August 19, 1853, and reissued April 17, 1863.'

"Ladd & Keen, of New York, N. Y., and Philadelphia, Pa., assignees of Watt & Burgess, London, England; improved process of treating wood or other vegetable substances in the manufacture of paper; patented August 19, 1853; reissued April 7, 1863.'"

(Question objected to by Thomas A. Jenks, esq., counsel for complainants, both for form and substance. Question withdrawn.)

3. Q. "Can you produce a portion of each of the specimens on file in the matter of Charles Watt and Hugh Burgess, patent of July 18, 1854, together with a copy of the labels attached to said specimens on file?"

(Question objected to by Mr. Jenks.)

A. "I can, and now produce them, marked respectively L, D, G, and C, J, Nos. 1, 2, 3 and 4. Exhibit 66 is a copy of the labels annexed to said specimens."

4. Q. "Do these numbers on the bottles correspond with the numbers on the specimens, or not?"

A. "They do."

5. Q. "Please state whose initials are on the bottles besides your own, and whether that party was present or not at the time they were sealed, and whether or not he placed his initials thereon."

A. "Leonard D. Gale's initials are on the bottles, signed by him in my presence, and they were sealed in his presence."

6. Q. "By whom were the labels of the date of 1858 and 1863 affixed to the original specimens on file in the office?"

497 A. "By myself."

7. Q. "Did you hand to William Shoemaker a small portion of each of these specimens in a sealed envelope?"

(Objected to by Mr. Jenks.)

A. "I did."

CORNELIUS JACOBS.

The counsel for plaintiffs is present, also Hugh Burgess.

Sworn to and subscribed before me this seventeenth day of May, 1867.

EDMUND F. RROWN,
United States Commissioner.

I certify that I tendered cross-examination to the counsel for plaintiffs, T. A. Jencks, esq., and he declined.

EDMUND F. BROWN,
United States Commissioner.

DISTRICT OF COLUMBIA, *County of Washington, ss:*

I, Edmund E. Brown, a United States Commissioner for the District of Columbia aforesaid, do hereby certify that the reason for taking the foregoing deposition is, and the fact is, the witness is material and necessary in the cause in the caption of the said deposition named, and that he resides over one thousand miles from the place of trial of said cause. I further certify that a notification of the time and place of taking the said deposition was made out and served

on the counsel for the plaintiffs, to be present at the taking of the said deposition, and to put interrogatories, if he or they might think fit, as appears by the original notice hereunto annexed.

I further certify that, during the taking of the said deposition, I was attended by George Harding, esq., counsel for the defendants; by Thomas A. Jencks, esq., and Hugh Burgess, on the part of the plaintiffs; the witness, who is of sound mind and lawful age; and the witness was by me first carefully examined, and cautioned and sworn to testify the truth, the whole truth, and nothing but the truth; and the deposition was by me reduced to writing in the presence of the witness, and from his statements; and after carefully reading the same to the witness, he subscribed to the same in my presence. I have retained the said deposition in my possession for the court for which the same was taken.

And I do further certify that I am not of counsel nor attorney for either of the parties in the said deposition and caption named,
498 nor in any way interested in the event of the cause named in said caption.

In testimony whereof, I have hereunto set my hand and official seal this seventeenth day of May, in the year of our Lord one thousand eight hundred and sixty-seven, and of the independence of the United States the ninety-first.

EDMUND F. BROWN,
United States Commissioner for the District of Columbia.

To E. H. WALLACE, esq., solicitor for complainants:

SIR: Please to take notice that I will take the deposition of witnesses on behalf of defendants in the above case, on Friday next, May 17, 1867, at the office of Edmund F. Brown, F street, east of Seventh two doors, at ten a. m., and continue to 6 p. m., from day to day, till the testimony is concluded.

May 12, 1867.

GEORGE HARDING,
Solicitor for Defendants.

Received within notice.

H. E. WALLACE.

May 12, 1867.

Exhibit 66.—*Copy of Patent Office labels.*

"Charles Watt, London, and Hugh Burgess, of the city of London, England; improvement in the manufacture of paper from wood: patented July 18, 1854; patented in England August 19, 1853.

"Ladd & Keen, of New York, N. Y., and Philadelphia, Pa., assignees of Watt & Burgess; improvement in the manufacture of paper from wood: patented July 18, 1854; ante-dated August 19, 1853; re-issued October 5, 1858.

"Ladd & Keen, of New York, N. Y., and Philadelphia, Pa., assignees of Watt & Burgess, of London, England; improved pulp from wood, etc., for the manufacture of paper: patented August 19, 1853, and re-issued April 17, 1863.

"Ladd & Keen, of New York, N. Y., and Philadelphia, Pa., assignees of Watt & Burgess, of London, England; improved process of treating wood or other vegetable substances in the manufacture of paper: patented August 19, 1853: re-issued April 7, 1863."—Exhibit 66.

EDMUND F. BROWN,
United States Commissioner.

499 MAY 18, 1867.

Present: Messrs. Wallace and Harding.

Leonard D. Gale, being duly sworn, doth depose and say:

1. Q. "What is your name, age, residence, and occupation?"

A. "Leonard D. Gale. I have been residing in New York, but am about to move to Washington. I am a chemist and patent soliicitor. I was examiner-in-chief in the United States Patent Office from 1847 to 1858. I had charge of chemical processes, among others. My age is sixty-five years. I left in the end of 1857."

2. Q. "State whether or not you were the examiner whom the application of Watt & Burgess for the patent granted to them July 18th, 1854, for an improvement in the manufacture of pulping and disintegrating substance."

A. "I was the examiner."

3. Q. "Were or were not specimens of the process filed at the time of making their application?"

A. "There were."

4. Q. "Have you or not enclosed in the sealed vials, in the presence of C. Jacobs, the machinist, at the Patent Office, a small portion of each of those specimens from the file of the Patent Office, and affixed four initials to the seal of each of the said vials?"

A. "Yes, sir; I have enclosed the said specimens in said vials, and affixed my initial thereto. I did this at the Patent Office, in the presence of C. Jacobs."

5. Q. "Have you examined four vials sealed up and marked L. D. G., C. J., and E. F. Brown, now filed in the United States Court of this city, in the cause annexed to the deposition of Cornelius Jacobs? and if so, state whether or not they are the specimens which you referred to in your answers, 3 and 4."

A. "I have examined the above vials. They are the same which I sealed up in the United States Patent Office, and they correspond with the specimens filed, and are a portion thereof."

6. Q. "Do they represent all the specimens filed, and do the numbers in these vials correspond with the numbering on the specimens?"

A. "They represent all the specimens filed, and the labels correspond with the numbers on the original packages."

Cross-examined.

By Mr. Wallace:

1*. Q. "Where did you put these specimens in the vials?"

500 A. "Some time in the winter of 1866 and 1867. I rather think it was in January, 1867."

2*. Q. "Were you at that time an employé in the Patent Office?"

A. "No, sir; I was not."

3*. Q. "How did you get access to the original specimens?"

A. "I presume by Mr. Harding obtaining permission of the Commissioner of Patents. This is the custom when a suit is pending."

4*. Q. "How were the original specimens put up?"

A. "They were in small wide-mouthed bottles. I am not certain they were in bottles. They were in packages."

5*. Q. "Then you found them in the Patent Office as the samples?"

A. "Yes, sir."

6*. Q. "You put them up at the request of Mr. Harding?"

A. "Yes, sir.

7*. Q. "Do you mean to say, of your own knowledge on the subject, that these specimens are samples of the identical specimens that were filed in the office when you held the official position of examiner in 1854?"

A. "Yes, sir; I do. They are labeled at the time they are filed, and laid away, and become a part of the archives of the office. Mr. Jacobs is the machinist that keeps the key. I recognize these as part of the specimens filed."

8*. Q. "Then you identify these specimens irrespective of the fact that you found them in the Patent Office?"

A. "I recognize the samples as being of the same colors and the same form of materials, and identify them by their appearance, in addition to finding them in their proper place."

LEONARD D. GALE.

Sworn to and subscribed before me this 18th day of May, A. D. 1867.

CHA'S SERGEANT,
U. S. Comm'r.

Adjourned to May 20th.

501 *Defendant's exhibit No. LXIII.—Rogers' testimony.—Description des machines et procedes.*—2,666.

Brevet d' invention de Quinze ans, (p. 95.) Endate du 20 mars, 1847. Au sieur GROS, aux Batignolles (Seine.) Pour l'emploider genet dans la fabrication du papier.

La plante du genet peut etre convertie enpate a papier en toutes saisons; au moment meme au elle vient d'etre, &c.

"Pour une pate destinee aux diverses qualities de papiers blancs, il y aura lieu de lessiver de six a huit hueres environ, pendant le

printemps et l'ete, avec environ 10 p, $_0^0$ du volume d'eau de sel de soude et 5 p. $_0^0$ dechaux grasse, et huit a douze heures environ, pour du genet cueilli pendant l'automne et l'hiver, en composant sa lessive avec environ 15 a 20 p. $_0^0$ du volume d'eau de sel de soude, rendu caustique avec environ 5 p. $_0^0$ de chaux grasse."

* * * * * * * *

[For a pulp intended for various qualities of white paper, this treatment must last for six or eight hours in spring and summer, with about ten per cent. of the volume of water of salt of soda, and five per cent. of good caustic lime, and the same operation continue eight or twelve hours for broom gathered in autumn and winter, composing the lye of about fifteen or twenty per cent. of the volume of water of salt of soda rendered caustic by about five per cent. of good caustic lime.]

"Quant au bois, depouille de son ecorce, qu'on a du mettre a part apres l'operation du laminage, il doit etre mis a une lessive en vase clos, avec une pression de trois ou quatre atmospheres environ. Cette lessive sera composee de meme que celle precedemment decrite et devra avoir la meme duree, apres la lessive, le bois doit immediatement, et sans avoir ete lave, etre place sur l'aire d'ecrasement et broye avec le rouleau, jusqu' a ce qu'il presente l'aspect d'une matiere textile effilochee. A pres cela, il devra subir une deuxieme lessive; semblable a la premiere, puis bien lave au cylindre, effiloche ensuite completement et plus fin que pour le chiffon; presse
502 soumis au chlore gazeax, lave, mis au chlorure de chanx, lave raffine."

[* As to the wood from which the bark has been taken, that was to be set aside after the crushing, this is to be placed in a lye in a close vessel, with a pressure of about three or four atmospheres. This lye is to be made in the same way as that described above and should act upon the material the same length of time. After the treatment with lye, the wood is to be immediately placed, without washing, upon the crushing space, and crushed with the roller, until it looks like a textile material torn in shreds, "effilochee," half stuff. After that, it is to be a second time and in like manner treated with lye, then washed well in the cylinder, and afterwards torn up completely and finer them rags are; then pressed, submitted to chlorine gas, washed and refined. After this last operation, one can either mix the wood with the other white pulps, or use it alone, to make of it a paper that shall be peculiar for its silky fineness, and the satin-like appearance that it will present, without having been submitted to a polishing. or to the action of anything to make it smooth.]

This passage is a correct translation of the original, although that much of the French is not extended.

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* The last paragraph in English corresponds with the original French, but the French is not printed in the foregoing extract.

Specification of patent of Jno. W. Dixon.

To all whom it may concern:

Be it known that I, John W. Dixon, of the city of Philadelphia and State of Pennsylvania, have invented a new and useful apparatus for making paper-pulp from wood, straw, or other analogous vegetable fibrous material; and I do hereby declare that the following is a full and exact description of the same, reference being had to the annexed drawings.

The nature of the improvement consists in combining with a wood or straw pulp-digester a circulating pump, (4) whereby the digesting liquor is forced to circulate continuously from the bottom or end of the digester, on to the top of and through the vegetable fibrous mass to be pulped, and also in combining with such a digester and pump, an intermediate coil for equivalent heating apparatus,
503 through which the digesting liquor shall be forced and heated, while in its passage from the bottom or end of the digester on to the top of the vegetable fibrous material to be pulped within the digester. See annexed drawing. A represents the pulp-digester, which is a boiler made of strong iron, capable of resisting a pressure of from one hundred to three hundred pounds, say four feet in diameter and twelve feet high. It is furnished with a man-hole cover B and a perforated diaphragm C and central removable cover D, and a lower perforated diaphragm E, with a sliding valve. F is a conical coil built in a furnace, and connecting at its lower extremity with the lower part of the pulp-digester A, by means of the tube 1, 2, 3, and 4, a rotary or other pump is placed in the course of this tube. The upper part of the coil or heater F is connected by the tube 6, with the interior of the digester A, at its top.

The upper diaphragm, C, may be ommitted, and a rose-head or tubular sprinkler may be attached to the extremity of the tube 6. Instead of the coil, F, a vertical tubular heater, such as used in locomotives, may be used, or no heating apparatus need be placed in the course of the circulating apparatus at all. In the latter case, the pump will operate to cause a constant circulation from the bottom on to the top of the digester A. This apparatus may be used to digest wood, straw, or other analogous vegetable fibrous material, either with highly-heated water under pressure alone, or with dilute solutions heated and under pressure of caustic soda, carbonate of soda, or other liquid capable of digesting or pulping wood, straw, other analogous vegetable fibrous material under pressure. The operation of the apparatus, is as follows: The wood, straw, or other analogous vegetable fibrous material is placed in the digester A, through the man-hole B, and the digesting liquid is then fed in. The man-hole is then closed tight, and the fire made, and the pump started, causing a rapid circulation of the hot digesting liquid continually from the bottom on to the top of the material within the digester. Heat is applied to the liquid while passing through the tubes from the bottom to the top of the digester, or it may be applied directly to the bottom of the digester. After the pulping

has been completed, the valve in the lower diaphragm is opened, and the pulp withdrawn to other vats or tanks for bleaching.

504 Having thus described my approved apparatus, what I claim as my invention, and desire to secure by letters patent, is:

The combination of the circuiating-pump, the pulp-digester and heating-coil, or its equivalent, for heating the liquid while being made to circulate by the pump.

JOHN W. DIXON.

Witnesses:
CHARLES H. WHITE.
J. E. MCCAULLEY.

MAY 21, 1867.

Present: Messrs. Harding and Wallace. Adjourned to May 22d, at 12 o'clock, m.

MAY 22, 1867.

Present: Messrs. Harding and Wallace.

Mr. Harding offered and put in evidence certified copies of letters patent issued to John W. Dixon, of Philadelphia, Pennsylvania, dated the sixth day of December, A. D. 1864, and numbered 45,321; also letters patent issued to John W. Dixon, dated the twenty-sixth day of June, A. D. 1865, and numbered 55,835.

(Mr. Wallce objects.)

Adjourned to May 23, 1867. Present: Messrs. Harding and Wallace.

1. Q. "What is your name, age, and residence?"

A. "My name is William Shoemaker. I am twenty-four years old, and reside in Philadelphia."

2. "Did the machinist who has charge of the models at the Patent Office, C. Jacobs, hand to you four envelopes? and if so, state whether they were sealed and marked with his name?"

A. "He did about two weeks ago; they were sealed and marked with his name."

3. Q. "State to whom you delivered these packages, and state whether they were in the same condition when you delivered them as when you received them?"

A. "I delivered them in person to Dr. B. H. Rand, and they were sealed, and I delivered them in the same condition as I received them."

Each of the above questions and answers objected to by Mr. Wallace.

W. L. SHOEMAKER.

Sworn and subscribed before me this twenty-third day of May, A. D. 1867.

CHAS. SERGEANT,
U. S. Com'r.

MAY 23.

1. Q. "What is your name, age, residence, and occupation?"

A. "Robert E. Rogers. I am forty-nine; reside in the city
505 of Philadelphia. I am a professor of chemistry in the University of Pennsylvania."

2. Q. "Have you translated French scientific works?"

A. "I have participated in the translation of Gay Lussac's methods of gold and silver assaying in connection with minting matters."

(Objected to by Mr. Wallace, both question and answer.)

3. Q. "Please translate the passage in the sixth volume of Dumas Traite de Chimie Appliquer Aux Arts, 1843, vol. 6, page 16, article 3,381?"

A. "I now furnish you a translation of it."

(Hereto annexed marked Exhibit 63.)

4. Q. "Have you tried any experiments to ascertain the effects of treating wood with a solution of caustic alkali at high temperature? If so, state the experiment and product any exhibit illustrating the result?"

(Objected to.)

A. "I have made the following experiment, to wit: 300 grains of poplar wood in small slices were treated with 1,500 grains of a solution of caustic soda, marking 12° of Beaume or 17° of Twaddell were put into an iron tube capable of holding 2,350 grains of water heated in a paraffine bath from 400° Fahrenheit to 480° Fahrenheit during four hours, the temperature being for the most part 465°; the tube was cooled and opened; there escaped some incondensible gas of strong odor resembling methylic alcohol. The contents were poured out and examined; the solution was a deep black liquid with neither woody fibre nor pulp visible. The bottle here presented contains the said contents."

(Bottle marked Exhibit 1, Rogers.)

"The tube was hermetically closed during the operation, and the materials therefore were exposed to a pressure due to the temperature."

5. Q. "Have you examined the original letters patent of Watt & Burgess, July 18, 1854, defendant's Exhibit 47, and the reissued letters patent of Ladd & Keen, annexed to complainant's bill, April 7, 1863, Exhibit 'B,' reissue No. 1,449? and do you understand the inventions therein described?"

(Objected to.)

A. "I have examined the said exhibits, and believe that I understand their language and intention."

506 6. Q. "Please state whether or not you find in said reissue No. 1,449 any invention not contained in the original patent of 1854, defendant's Exhibit 47, and whether or not the invention contained in the reissue No. 1,449 is essentially different from that contained in the original patent of 1854, and give your reasons for the opinion?"

A. "I do find in said reissue No. 1,449 an invention not contained in the original patent of 1854, and that invention is essentially dif-

ferent from the one contained in the patent of 1854, and the following are my reasons for so stating:

"In the patent of 1854 the process for paper pulp making, as distinguished from bleaching, consists of three successive steps in especial alternation with each other, as essential, in which a weak alkali is used, to be boiled with the woody material, alternated with the treatment of the material by chlorine, and the subsequent boiling of the material with the weak alkaline solution, in which operations pressure is in no wise essential as a feature. In the reissue of 1863 the process for the making of pulp, as distinguished from bleaching is a single step, or consists of a single step, in which the use of the alkaline liquid of high strength and of high pressure is made of essential importance. The three-step process, exhibiting the specific alternation in the use of the materials designated in the first-named patent, namely, of 1854, would not at all lead to or suggest the single-step process of the patent of 1863, but, on the contrary, would suggest to a chemical expert that nothing other than the three-step alternating process of the patent of 1854 would accomplish the result of producing pulp from wood, and therefore I regard the two as distinct inventions."

7. Q. "Please examine defendant's Exhibit 56, and state whether or not it is a correct extract from the brevet d'invention of Sieur Gros, of March 20th, 1847, and whether or not you have verified translations of the passages contained there."

(Question objected to.)

A. "Yes, sir; I have so examined and compared the exhibit, and find it correct, and the translations correct."

8. Q. "Do you know the temperature at which hydrogen is evolved?"

(Question objected to.)

A. "By the testimony of Dumas, whose experiment is quoted by Hoffman in the report of juries of the English exhibition of
507 1862, it appears that when wood with the mixed alkalies is heated to a temperature beyond 485° hydrogen was evolved."

9. Q. "In the first passage quoted from Gros's patent, would there be difficulty, and if any, what, in preparing caustic solution of soda by the original description of Gros?"

(Question objected to.)

A. "In my opinion there would not."

10. Q. "State how you would do it."

(Question objected to.)

A. "To prepare the solution described by Gros, I would use ten per cent. of the soda ash to the water, making a solution of said soda ash in the water, and treating said solution by five per cent. of good caustic lime, agitating the materials thoroughly together, and decanting the supernatent liquid."

Cross-examined.

By Mr. Wallace:

1*. Q. "To what extent are you practically acquainted with paper making?"

A. "To the extent of having visited paper factories, and studied in books on the subject, the details and process of the manufacture."

2*. Q. Have those visits and that study been recent or of old date?"

A. "They have been at intervals dating back twenty years to within the past nine months."

3*. Q. "When did you make the experiments referred to in your answer to question four?"

A. "Within the past five days."

4*. Q. "Have you made any other experiment on the same or similar materials; and if so, when and how?"

A. "This is the only experiment of this specific kind that I have made, though I have experimented on paper-making materials, as a matter interesting me in science, at other times."

5*. Q. "Did you open the tube during the operation?"

A. "I did not, but retained it closed from the beginning until the end."

6*. Q. "What do you consider the substance produced by your experiment to be?

A. "Without being able to say specifically what new compounds are produced by the original elements of the wood, I believe that the material exhibited is made up of several substances which
508 have resulted from the destruction totally of the wood itself, and of the rearrangement of the ultimate constituents of the wood into less compound products, this being in accordance with the testimony of chemists that when such organic substances as wood are heated to a very high temperature with alkalies."

7*. Q. "How did you prepare the caustic alkali used in that experiment?"

A. "I did not prepare the alkali, but used that which was furnished by the firm of Powers and Weightman, bearing their label and stamp."

8*. Q. "Was the strength indicated by them or ascertained by you?"

A. "The strength was not indicated by them, but was made use of in solution so dilute with water as to indicate the specific gravity of 17 Twaddell, English hydrometer."

9*. Q. "How long prior to this experiment was it that you made any former experiments?"

A. "The last experiment I made prior to this one was two weeks ago."

10*. Q. "When was your attention first called to the Watt & Burgess patents to which you have alluded in your answer to question six?"

A. "Within the last fortnight."

Re-examined.

By Mr. Harding:

1. Q. "Have you examined the specimens on file in the Patent Office, in the matter of Watt & Burgess' application for a patent in 1854?"

(Question objected to.)

A. "I have examined four specimens in the Patent Office, so labelled."

2. Q. "Have you examined the report of experiments made by Dr. Rand, contained in table marked Exhibit B, annexed to Dr. Rand's testimony?"

A. "I have carefully inspected the table referred to. I did so before making my experiment."

3. Q. "Did you carefully examine the two specifications on which you gave your testimony-in-chief, of Watt & Burgess, 1854, and the reissue of Ladd & Keen of 1863?"

A. "I did carefully examine them."

R. E. ROGERS.

Sworn to and subscribed before me this twenty-third day of May, A. D. 1867.

CHAS. SERGEANT,
U. S. Comm'r.

509 MAY 20, 1857.

Parties met pursuant to adjournment at 10 a. m. Present: H. E. Wallace, esq., for complainants, and Geo. Harding, esq., for defendants.

Lemuel W. Wright, a witness on behalf of defendants, being duly sworn, doth depose and say, as follows:

1. Q. "What is your name, age, residence, and occupation?"

A. "Lemuel Wellman Wright, seventy-seven years of age, reside at 186 Clinton street, Brooklyn, and am a mechanical and civil engineer. I was born in New Hampshire."

2. Q. "Did you ever have a bleaching mill at Stockport, England? If so, state when you had such a mill, and what you bleached there."

(Objection by complainants.)

A. "I had a mill at Stockport, Cheshire county, England, for bleaching various fibrous substances, such as cotton, cloth, yarns, and threads. This was commenced about 1839."

3. Q. "Are you a native of England?"

(Objection by complainants.)

A. "No; I was born at Plainfield, Sullivan county, New Hampshire."

4. Q. "In bleaching, as you have stated, did you boil the materials to be bleached in caustic alkali solutions, under pressure? If so, what pressure did you use?"

(Objection by complainants.)

A. "I did boil the materials in a solution of caustic alkali, under pressure. The pressure was from forty to eighty pounds."

5. Q. "Are you the person named in letters patent granted in England in 1843, and in the United States in 1847, for process and machinery and apparatus for bleaching vegetable fibrous substances and manufacturing the same into paper?"

(Objection by complainants.)

A. "I am."

6. Q. "In the said patents, in describing the nature of your invention, you mention the peculiar apparatus or machinery employed for the purpose of boiling fibrous substances, straw, jute, wood, &c., by high-pressure steam. What degree of pressure did your boilers bear when made under said patent?"

(Objection by complainants.)

510 A. "I had four boilers. In one of them I worked forty to eighty pounds. In the others I did not work so much."

7. Q. "Have you made any paper from straw according to the process indicated and described by the patent? If so, when and where did you make such paper? Please produce a sample or samples if you are able to do so?"

(Objection by complainants.)

A. "I have made paper at St. Mary's mills, and at Chalford, Gloucester county. (The samples produced marked C. S., L. W. W., No. 1.")

"These are portions of paper which I made at Chalford, and the paper made from it at St. Mary Crag. I can't give you the date exactly, but about 1850."

(Answer objected to by complainants.)

8. Q. "How was the straw from which the paper was made treated?"

(Objected to by complainants.)

A. "It was treated according to my patent by high pressure steam and caustic alkali."

9. Q. "What was the density of the solution? and what the pressure used?"

A. "The strength of solution was about 8° of hydrometer. The pressure from forty to eighty pounds."

10. Q. "Did you exhibit specimens of paper made by you from straw under your patent at any of the public exhibitions?"

A. "I did at the great exhibition of works of industry of all nations, at London, 1851, and I got a prize medal. Application was made to me by Dr. Lyon Playfair on behalf of the lords of the committee of privy council for specimens to exhibit at the Paris exhibition in 1855. I furnished specimens of straw paper to Dr. Lyon Playfair as requested."

11. Q. "Please produce Dr. Lyon Playfair's note, that the commissioner may make a copy and annex it to the deposition as an exhibit?"

A. "This is it."

(Witness produces a letter of which C. S., L. W. W., No. 2, hereto annexed, is a copy.)

12. Q. "Was there any other material except straw in exhibit C. S., L. W. W. No. 1? and if so, what?"

511 (Objected to by complainants.)

A. "No, it was made from wheat straw alone."

13. Q. "Can you produce any specimens made from straw alone, at an earlier date than 1850? If so, produce them?"

(Objected to.)

A. "Exhibit C. S., L. W. W., No. 3, was made by the process described in my patented process of 1843, between the date of my English patent, and the patent of 1845. This was made at Chalford. Exhibits four and five were made in 1848, from pulp made at Chalford, by the same process. These were made from straw alone."

14. Q. "Was your mode of boiling straw in caustic alkali under high pressure of from forty to eighty pounds known in England in 1851? and if so, to what extent?"

A. "I believe it was generally known."

15. Q. "Can you produce a specimen of pulp made according to your patented process from straw alone, and if so, produce the same, and state when it was made?"

A. "I produce a specimen marked C. S., L. W. W., Exhibit No. 6. This was made at the same time and place as the pulp from which Exhibit 1 was made."

16. Q. "How did you in your said process discharge the boiler?"

(Objected to.)

A. "By bringing the steam on top the pulp, and discharging it through a pipe and cock in the bottom of the boiler into another vessel, up to a certain height."

17. Q. "What was the per centage of white paper which you obtained by your patented process from straw?"

A. "About thirty-three per cent."

18. Q. "What do you understand strong lye to be composed of in England?"

A. "A solution of water and soda or potash caustic."

19. Q. "How was it prepared?"

A. "It is boiled in an iron vessel and steam let into it, and water and soda, and stirred with lime by an agitator." About one bushel of lime to two bushels of soda ash is the proportion. About one pound of soda ash to a gallon of water and lime, in the proportion above, will give a lye of about 16° English."

20. Q. "How much caustic soda was used to a hundred pounds of the white paper produced?"

512 A. "From thirty to forty to make white paper from wheat straw; it would take less to make white paper from oat or rye straw."

21. Q. "Did you ever exhibit your process to any Frenchman by the name of Mellier? and if so, for what purpose?"

(Question objected to.)

A. "Two Frenchmen of the name of Muller & Mellier, called on me at St. Mary's mill, Chalford, and wished to have my process of making paper from straw explained. I took them over the mill and

explained the whole process. They then stated they wished to purchase my patent in France. I entered into an agreement with them; they were to pay me six thousand pounds for it; they failed; they became bankrupts, and gave me notice to prove my demand, which I took no notice of."

Mr. Harding produces the witness for cross-examination, and it is agreed between the counsel for the parties, that Mr. Wallace may cross-examine the witness at any time within the next ten days, and on giving five days' notice Mr. Harding will produce him, and in case Mr. Wallace does not give such notice of cross-examination within five days to Mr. Harding, cross-examination is understood to be waived.

LEMUEL W. WRIGHT.

Sworn to and subscribed before me this twentieth day of May, A. D. 1867.

CHAS. SERGEANT, *U. S. Comm'r.*

MAY 25, 1867.

Present: Messrs. Harding and Wallace.

Lemuel Wright's deposition continued.

1. Q. "Please examine Exhibit H, four, and state how the digested straw or pulp therein compares with the straw pulp as discharged from your digesters."

(Question objected to by Mr. Wallace)

A. "Mine was very much the same as this, though lighter in color."

2. Q. "Can you produce a specimen of brown paper made by your process from straw, without the use of chlorine or other bleaching material?"

(Question objected to by Mr. Wallace.)

A. "I produce a specimen marked Exhibit L. W. W., No. 7, and say this was made by alkali alone, without chlorine or other bleaching material. It has been colored with a little copperas."

3. Q. "Can you produce the medal to which you alluded in your former answer?"

513 (Question objected to by Mr. Wallace.)

A. "I can; it is marked L. W. W., Exhibit No. 8."

4. Q. "What is the difference in weight between white paper and brown paper?"

(Question objected to.)

A. "It took a ton and a half of wheat straw to make a ton of brown paper and three tons of wheat straw to make a ton of white paper. The white paper has a longer treatment under pressure, and requires more alkali."

5. Q. "In bleaching linen goods by caustic alkali under pressure, what per centage of the material was dissolved out by the action of the alkali in the process of bleaching?"

(Question objected to.)

A. "From twenty-five to thirty per cent., according to the quality of the flax."

6. Q. "State whether or not the action that takes place in the treatment of linen goods with caustic alkali under pressure is of the same or a different nature from that which takes place in the treatment of straw with caustic alkali under pressure, in the making of paper?"

(Question objected to.)

A. "The action in both cases is nearly the same. The effect produced is dissolving the coloring and gummy matter contained in the flax. There is considerable gum in flax, and a great deal more in straw."

7. Q. "Did you erect works for bleaching with caustic alkali under pressure in any place other than England?"

(Question objected to by Mr. Wallace.)

A. "Yes; in Ireland, in France, and in Russia. I had patents for England, Ireland and Scotland, for bleaching fibrous substances with caustic alkali under high pressure. The Irish linen manufacturers infringed my patent by setting up manufacturing establishments. I went there and set up a kier and found that about two hundred firms had adopted it previous to my going there. I brought actions against the parties. I did not succeed in consequence that at that time three distinct patents had to be taken out in each of the three United Kingdoms, and they were incorrectly dated. I allude here to my patents for bleaching linen, which I took out prior to my patents for making paper."

8. Q. "What was the effect of the preliminary lime treat-
514 ment that you gave your straw?"

(Question objected to by Mr. Wallace.)

A. "I gave no such preliminary treatment with lime."

Cross-examined.

By Mr. Wallace:

1*. Q. "Is the apparatus for making paper spoken of by you in your examination-in-chief, interrogatory 5, and subsequent interrogatories, correctly described in your specification, and were the specimens of paper produced in evidence, numbered respectively, 1, 2, 3, 4, 5, 6, and 7, made according to the process described in that specification?"

A. "It is the same apparatus as there described, according to the best of my recollection, and the specimens of paper here produced in the exhibits were so made."

(Mr. Wallace puts in evidence Exhibit L. W. W., No. 8, so marked by the commissioner. Witness says this is my specification; that is, I presume it to be a correct copy, as it is published by the government.)

2*. Q. "Did you erect that machinery as described in the specification at Chalford?"

A. "I erected kiers or boilers according to the specification, and also pulping apparatus; I cannot say every detail was the same, but the whole foundation principle was the same."

3*. Q. "I call your attention to the first plate, the pulping apparatus, sheet 1. Was the apparatus erected by you at Chalford in all respects according to that plate?"

A. "To the best of my recollection I used all the vessels there shown, and I think more.

4*. Q. Did you use them with the tubes and appliances and in the succession shown in your specification?"

A. "Yes, sir; as near as I can recollect. I could not recollect every screw that was there.

5*. Q. "What was the size and capacity of your apparatus that you erected at Chalford?"

A. "There are only two boilers represented here; I used four boilers. The boilers, to the best of my recollection, were six feet in diameter, with man-holes at the top to supply the straw. Their height I do not remember; I should think nine feet. One of the four boilers I used was about five feet in diameter, and about
515 eight feet high. Three of them were six feet in diameter and nine feet high."

6*. Q. "What position in the process did they occupy as marked on the plan?"

A. "A, on the plan was a lime tub; B, was a boiler. I most forget about this plan. I don't think I erected the tub B; I did without it. C, is a washing. The parts were all erected in the first instance as near as may be like the drawing; they were intended for white paper. The washing tubs afterwards were dispensed with, and ray engines put in the place of them."

7*. Q. "Which washing tubs were dispensed with?"

A. "B, C, E, G, and H, are washing tubs; they were all dispensed with because their place was found to be better supplied by a ray engine."

8*. Q. Then there remained of the steps of the process A, D, and F?"

A. "Yes; there remained A, D, and F. D was the pulping process."

9*. Q. "Then all the four boilers you have named occupied the position F?"

A. "Yes; they were placed in a row; they were not connected at all, but performed the same operation, and were intended to increase the capacity."

10*. Q. "How long was it after the erection of the apparatus, according to the specification as you say it was first erected, before you made the alteration you speak of by substituting a ray engine for the washers?"

A. "Well, I am sure I do not recollect; perhaps three or four months."

11*. Q. "What was the cost of this apparatus as originally constructed?"

A. "The whole plant cost from the first until it was in operation, about fifteen or sixteen thousand pounds, as near as I can recollect. I can't say as to this particular part."

12*. Q. "Did you get the four boilers at the time of the original erection or subsequently?"

A. "They were all erected at the same time."

13*. Q. "What amount of pulp were you able to produce by that apparatus per day?"

516 A. "Pulp enough was made to make about fifteen tons of paper per week."

14*. Q. "Was that from the start or after the alteration of the apparatus?"

A. "This was after the alteration took place; there was not much produced before."

15*. Q. "How much do you suppose was produced before?"

A. "I do not recollect; I cannot tell; cannot give an item at all. I am sure I do not recollect at all"

16*. Q. "What kind of paper was produced before the change?"

A. "There was some white paper made. Exhibit L. W. W., No. 3 is some of that that was produced."

17*. Q. "How much of that quality was produced?"

A. "About half a ton, as near as I can recollect."

18*. Q. "Was there any of any other quality produced before the alteration?"

A. "No; there was not."

19*. Q. "What became of the half ton that was produced?"

A. "It was sold, I believe."

20*. Q. "After the alteration, and you produced fifteen tons a week, what was the kind of paper that you produced?"

A. "Brown paper like Exhibit 7, jacqquered board, pasteboard."

21*. Q. "Was there any white printing paper produced?"

A. "No, sir."

22*. Q. "How long did you continue the manufacture of paper at Chalford?"

A. "I sold my interest out about 1845, and had nothing more to do with it. I always understood there were about fifteen tons a week produced."

23*. Q. "What length of time were you engaged in that business there?"

A. "I commenced in 1843, and sold out about 1845 or 1846."

24*. Q. "During the time you carried on the business there, did you make or lose money?"

A. "I did not make any money; what I sold for I never got paid, except £500 on signing the writings; I never got any more."

25*. Q. "Did you make any money by the manufacture of paper while you carried on the works?"

A. "I cannot answer whether any profit was shown on the

517 books; they ought to have made £10,000 a year, but the works got into bad hands."

26*. Q. "How much did you sell out for?"

A. "£11,000 was agreed to be paid."

27*. Q. "Why was it not paid?"

A. "After I left the concern, a young man was put into the

management of it who did not understand the business or any other. A young man that was sent to me from London by his father to keep him out of the streets. A lease was taken of seven, fourteen, or twenty-one years, at the option of the tenant with six months' notice. Notice was given and the place vacated at the end of seven years. They worked on until the seven years was out and then then they sold it off. I never sued for the amount of the agreement for the man had nothing to pay with."

28*. Q. "What were the terms upon which you sold? and who did you sell to?"

A. "I sold to Robert Alexander Cochran. They agreed to pay me at stated times during the lease. They paid £500 down."

29*. Q. "Was there anything in the terms of payment made to depend upon the success of the invention?"

A. "I don't recollect how that was."

30*. Q. "Did you ever make any demand for any portion of this eleven thousand?"

A. "I don't think I did."

31*. Q. "Did not this Mr. Cochran, the purchaser of that place, utterly fail and break up in that business?"

A. "He broke up the concern and sold it off."

32*. Q. "Who did he sell it to?"

A. "He sold it to some parties in the north of England. I do not know their names."

33*. Q. "Was it continued by the purchaser as a paper manufactory?"

A. "Yes. I left the concern because I could not agree with Cochran."

34*. Q. "Did you yourself derive any profit from the business?"

A. "Nothing but the £500 before mentioned."

35*. Q. "Did the sale you made to Cochran include the patent-right?"

A. "For that mill it did. I don't think it included the right for all England."

518 36*. Q. "What is your belief about that?"

A. "I believe it did not."

37*. Q. "Did you reserve any royalty for the use of the patent?"

A. "I think not. I do not remember that I reserved anything at all."

38*. Q. "It had cost them £15,000 to erect the works on a leasehold of land and buildings, and you sold that for £11,000?"

A. "That is so. £2,000 was used in the erection of buildings."

39*. Q. "Did you, at any other time, set up and put in operation any other apparatus for the manufacture of paper pulp in England according to your specification? and if so, where and when?"

A. "I fitted up a mill called Spring mill, at Chalford, about 1850, I think; I fitted up no other in England. About the time I applied for my patent I fitted up an establishment in Wales, called Hope mills, at which I never manufactured any paper for sale. I merely made it by way of experiment."

40*. Q. "At Spring mill, at Chalford, did you go into the manufacture of paper for sale?"

A. "No, that was for making pulp; that pulp was made into paper and some of sold?"

41*. Q. "How much pulp did you make?"

A. "I made a ton."

42*. Q. "Was that white paper or brown?"

A. "White paper."

43*. Q. "What amount was manufactured and sold?,'

A. "I made about a ton of pulp; it was sold by the paper-maker in the paper he made of it. He sold all except a portion that I kept."

44*. Q. "Was the mill you fitted up there fitted according to this specification?"

A. "On the same principle."

45*. Q. "What was the size of the apparatus?"

A. One high pressure steam boiler and one set of pulping rollers, and sundry other tubs and things. The boiler was about five feet in diameter and eight feet hieght. It was the small boiler that was used in the other works. I had bought it after they had been broken up."

46*. Q. "Was this mill so fitted up an experiment, or was it for the manufacture of paper pulp for sale?"

519 A. "It was fitted up for manufacturing pulp for sale, and for the want of capital it was given up."

47*. Q. "What amount of pulp was the apparatus calculated to produce?"

A. "About half a ton per day."

48*. Q. "Was it calculated to produce pulp for white or brown paper?"

A. "White paper; we made no brown there."

49*. Q. "Was that apparatus set up in accordance with the specification in your patent?

A. "It was upon that principle, but not like the plan there described."

50*. Q. "What was the process to which the straw was actually submitted at that mill?"

A. "It was in the first place cut in an engine about one inch long; then put into a boiler and boiled with caustic alkali and lime; then blown up by a pressure of steam through a tube to the washing engine; then it was washed again, then submitted to pulping rollers, then washed again, and bleached in tubs in a solution of chloride of lime. I put it into a press then, and pressed it into cakes. Exhibit L. W. W,, No. 6, is a piece of that cake; in that condition it was shipped to the paper maker."

51*. Q. "What kind of a boiler was that?"

A. "It was an upright cylinder boiler with spherical ends of wrought iron, with a man-hole at the top and a cover for screwing down; there was a pipe at the bottom and cock letting in the steam, and a pipe also in the bottom for throwing up into the washing, and also a pipe for letting in water."

52*. Q. "How was it heated?"

A. "By forcing steam into it; there was no fire under it."

53*. Q. "Had it a guage or a safety valve?"

A. "It had no guage, and I think it had no safety valve; there was a safety valve on the boiler which supplied the steam, and a gauge on that boiler too."

54*. Q. "What pressure did this particular boiler bear?"

A. "I worked about forty pounds to the square inch."

55*. Q. "How did you ascertain that pressure?"

A. "The safety valves on the boiler which furnished the steam would tell that."

520 56*. Q. "Then you had no other means of telling the pressure or temperature of the boiler in which the cooking was going on?"

A. "No, sir."

57*. Q. "Which of these specimens produced here are from that mill?"

A. "All the white paper except that printed one."

58*. Q. "Are those specimens the best paper you ever made by the process?

A. "Yes, sir."

59*. Q. "What was the difference in construction between the apparatus described in the American and English patents?"

A. "I have no recollection of any difference."

60*. Q. "Was any apparatus ever erected on the plan of the specification in the American patent?"

A. "There was no apparatus ever completed in this country. An attempt was made by Burroughs Hyde. I made an agreement with him in England to put up a mill here; he went into an agreement with another party after I left him, up the Raritan river. I gave drawings of the specification to him for that purpose. He caused to be made two high pressure wrought-iron boilers half an inch thick, I believe, which have since been removed from Raritan to Red Hook or South Brooklyn, and set up there for making paper from bamboo."

61*. Q. "He never then did put your apparatus in operation?"

A. "No; I believe not."

62*. Q. "What pressure did you use at St. Mary's?"

A. "From forty to fifty pounds."

63*. Q. "Was there any difference, and what difference, between the use of forty and fifty?"

A. "I do not know that I can describe any difference; I don't know if there would be much or any between boiling at forty or fifty pounds."

64*. Q. "Is the effect produced by boiling straw under pressure accurately described in your specification?"

A. "It was described as I then understood it."

65*. Q. "What boilers, if any, that you used, would bear a hundred pounds pressure in paper-making or the making of pulp?"

A. "I don't know that I ever stated that I had boilers that would bear a hunderd pounds in paper-making. I had boilers

521 near Stockport for boiling fibrous substances with caustic alkali, under high pressure, which were said to bear two hundred pounds pressure. I think they would bear one hundred. I worked them as high as ninety pounds pressure."

66*. Q. "These were bleaching works, were they not, and not paper-making works?

A. "They were bleaching works, and not for making paper. I boiled my first straw there."

67*. Q. "That was before you got your patent?"

A. "It was before I got my patent of 1843. I had another patent before that."

68*. Q. "Where were you when you took out your American patent?"

A. "I was living at Chalford."

69*. Q. "When did you return to this country?"

A. "I landed at New York, May 7th, 1857."

70*. Q. Did you reside in England most of the time after you obtained the patent of 1843, up to that time?"

A. "Yes; a greater part of the time."

71* Q. "Were there any other attempts to put in operation your process under your English patent of 1843, or your American patent of 1847, except those that you have mentioned in reply to my interrogatories?"

A. "I have no knowledge of any attempt as far as I recollect."

72*. Q. "When you say in your answer to the ninth interrogatory in chief, 8° of the hydrometer, what hydrometer do you mean?"

A. "I mean English in that answer. I mean to say I worked from forty to fifty pounds there. It was at Stockport that I worked from forty to eighty pounds on straw."

Re-examined.

By Mr. Harding:

1. Q. Where was it you boiled straw from forty to eighty pounds pressure?"

A. "Near Stockport. At Chalford I boiled it from forty to fifty pounds; I don't know how high a pressure was used at Chalford when I was not there."

2. "From your experience as a paper-maker, what difficulty, if any, is there in making white paper from straw boiled in caustic alkali, at a pressure of forty pounds?"

522 (Question objected to by Mr. Wallace.)

A. "From my knowledge and experience in paper-making, I do not think there is any difficulty whatever."

3. Q. How full was your digester?"

A. "Rather more than two-thirds, including the straw in solution. There was an expansion space in the upper part of the digester."

4. Q. "How long did it take you to discharge your boilers by the steam pressure, and state whether or not the pulp was in a condition to be forced through a pipe?"

A. "The pipe was of four inches diameter, the cock four inches, and the pulp could readily be forced through that pipe; supposing that the kier or boiler would hold a ton of straw and a sufficient quantity of a solution of alkali, it would be discharged in less than a minute.

Recross-examined.

By Mr. Wallace:

1*. Q. "What other experience have you of paper-making except what you have stated here?"

A. "I have none other, except in my own invention. I, of course, understand paper-making; the whole process.

2*. Q. "How many times did you put in operation your process for making white paper at St. Mary's mill, in manufacturing the ton of white paper first mentioned, of which Exhibit L. W. W., No. 3, is a sample.

A. "About two boilings."

Re-examined.

By Mr. Harding:

1. Q. "How long have you been engaged in boiling fibrous materials in caustic alkali under pressure?"

A. "Since about 1838 or 1839. I commenced to boil in caustic alkali fibrous substances about 1822; did not commence to boil under pressure until 1838. I was engaged in boiling under pressure about three years at Stockport."

Recross-examined.

By Mr. Wallace:

1*. Q. "For what purpose was the boiling in caustic alkali under pressure?"

A. "It was intended and was used for bleaching cotton and linen goods by removing the natural coloring and gummy matters, and I had a patent for an improved process of bleaching cotton and linen goods by boiling in caustic alkali under high pressure."

LEMUEL W. WRIGHT.

Sworn to and subscribed before me this twenty-fifth day of May, A. D. 1867.

CHARLES SERGEANT, *U. S. Comm'r.*

523 *Exhibit L. W. W., C. S., No. 2.*

DEPARTMENT OF SCIENCE AND ART,
MARLBOROUGH HOUSE, PALL HALL.
London, 18th day of February, 1855.

L. W. WRIGHT, Esq.

SIR: With reference to your interview with Dr. Playfair some time since, on the subject of making paper from straw, I am desired by

the lords of the committee of privy council for trade, to inform you that their lordships are desirous to exhibit in the French International Exhibition, about to take place, a case illustrating the information communicated to the Board of Trade on the important subject of providing a substitute for rags in the manufacture of paper.

I am, on the part of their lordships, to request that you will contribute to this collection a series, showing your experiments in making various kinds of paper from straw. Several ounces of the raw material of the pulp in its bleached and unbleached state, &c., a quire of each variety of paper would best suit the illustration intended.

Should you desire to see Dr. Playfair on this subject, he will be glad to make any further explanations of the manner of exhibiting.

I have the honor to be, sir, your obedient servant,

LYON PLAYFAIR.

MAY 28, 1867.

Present: Messrs. Harding and Wallace.

Mr. Burgess, produced on the part of the respondents, being sworn, said:

1. Q. "Have you visited England recently? and if so, did you, while there, see Mr. Charles Watt?"

(Question objected to by Mr. Wallace.)

A. "I did visit England, and there saw Mr. Charles Watt."

2. Q. "Was the Watt & Burgess patent of 1853 enrolled in 1854, ever introduced into practical operation in England, or were licenses ever granted under it?"

(Question objected to.)

A. "Works were put up and the process commenced on a small scale. Owing to a misunderstanding between the gentlemen
524 engaged in it, the operation fell through. This happened in two instances. No licenses have been granted to work the process in England. I would add that, owing to Mr. Watt's advanced years, he was personally able to move but little in the matter, and this, as I understand, was the principal cause of failure."

3. Q. "When were those operations commenced which fell through?"

(Question objected to.)

A. "I am unable to give the dates, but I believe that the two attempts to start the process had perhaps an interval of three years between them. The first attempt, as near as I can recollect, was in 1854 or 1855, probably the summer of 1854; but of this I am not certain."

4. Q. "By whom were the second operations which fell through undertaken?"

(Question objected to.)

A. "I do not know the names of any of the parties, as I left the matter in the hands of Mr. Charles Watt entirely."

5. Q. "Was any paper ever made under this patent in England?

and if so, how much, and what amount of money was in any way realized from the English patent?"

(Question objected to.)

A. "Some hundreds of pounds of paper were made at Boxmore in 1853 or 1854. This might have been previous to the granting of the patent. I am not aware as to the amounts of paper, if any, since the granting of the patent, that have been made in England. My impression is that some quantity has been made since the granting of the patent. I am not aware of any money having been received for the same patent in England; at any rate, I have received none from that source."

6. Q. "What do you mean by the expression, some quantity? and state where and by whom the paper to which you allude was made."

A. "I am under the impression that perhaps a ton or more paper was made; but I am quite ignorant of the detail of the facts as to how and where it was made, or when it was made."

7. Q. "Are you not aware that in England an immense amount of paper has been made by boiling Esparto grass in caustic alkali under pressure?"

525 (Question objected to by Mr. Wallace, who instructed the witness he was only to answer from his own knowledge.)

A. "I have heard that large quantities of paper are made in England from Esparto grass, by boiling it in caustic alkali under pressure."

(Answer objected to by Mr. Wallace.)

8. Q. "Did you or Mr. Watt ever assert any legal claim or right against parties in England making pulp or paper by treating Esparto grass in caustic alkali under pressure?"

(Question objected to.)

A. "We have not."

9. Q. "Are you aware that pulp has been made in England in considerable quantities by boiling straw in caustic alkali under pressure?"

(Question objected to by Mr. Wallace, who again instructed the witness to answer only from his own knowledge.)

A. "I have heard that large quantities of straw are converted into pulp and paper by boiling straw in caustic alkali under pressure in England."

10. Q. "Has any legal claim ever been asserted, on part of your patent, against any such parties?"

(Question objected to.)

A. "There has not."

11. Q. "What amounts have Mr. Watt and yourself realized, directly or indirectly, from the American patent granted to you in 1854, or from either of the reissues thereof?"

(Question objected to by Mr. Wallace as impertinent, who also instructed the witness that he had a right, if he choose, not to answer it.)

A. "I have already answered the question in my previous cross-

examination, when called as a witness for the complainants, in my answer to question 143, where I state I believe my share was about two thousand pounds, received from H. B. Honghton in the shape of his notes, some of which have not been paid."

12. Q. "Is that the fullest and most precise answer which you can now make to that question?"

A. "I can give from the book, which I hold in my hand, the exact amounts of the cash paid me, and the notes given for the purchase of the Watt & Burgess patent. It was as follows: I
526 received in cash, from Mr. Houghton, six hundred and seventy-five pounds, and subsequently, cash or drafts to the amount of one hundred and fifty pounds, and Mr. Houghton's note of hand, at eighteen months, for one thousand five hundred and sixty-two pounds and ten shillings; also his note, at nine months, for nine hundred and thirty-seven pounds and ten shillings, which two notes I remitted to Mr. Watt. I also received two notes, at nine and eighteen months, for my share of the purchase of the patent, which are not down in the book I hold. The total amount of the purchase money was five thousand pounds. The book to which I refer above is the Testimony and Exhibits of the American Wood-Paper Company *vs.* The Fibre Disintegrating Company, in my testimony given in that case, in answer to questions 25 and 26 of my cross-examination."

13. Q. "Did you not, within the last two weeks, file a statement of the exact amount realized by you and Mr. Watt of all you had received from the American patent?"

(Question objected to by Mr. Wallace, who said if there be such a statement it should be produced.)

A. "I did."

14. Q. "What amount did you allege there that Mr. Watt and yourself received?"

(Question objected to by Mr. Wallace, on the same grounds.)

A. "To the best of my recollection, I stated that Mr. Watt received six hundred and fifty pounds, and I received one hundred and eigty-six pounds. I believe those were the amounts. I copied them directly from my account book, and do not remember the precise figures."

15. Q. "Have you not had an interest of one-third in the Ladd & Keen reissues, prior to and since their grants of 1858 and 1863?"

(Question objected to by Mr. Wallace as impertinent and irrelevant, and the witness instructed as before.)

A. "Messrs. Ladd & Keen gave me about one-third share, in consideration of my remaining in this country and aiding them in working the patents."

16. Q. "What amount have you realized from the Ladd & Keen reissues?"

(Question objected to by Mr. Wallace for the same reasons as above.

527 A. "I realized my share in the stock of the American Wood Paper Company, namely, about nine hundred and sixteen shares of the stock, at a par value of one hundred dollars per share, and a salary as chemist."

17. Q. "Prior to the organization of the American Wood Pulp Company, and the receipt of that stock by you in 1863, you realized nothing from the reissues to Ladd & Keen?"

(Question objected to by Mr. Wallace.)

A. "Not that I remember."

18. Q. "Did you consent, as a stockholder, to the purchase of the Mellier patent, or did you oppose the purchase in any way?"

(Question objected to by Mr. Wallace.)

A. "I neither opposed nor acquiesced, as I did not attend any of the meetings in which that subject was discussed."

19. Q. 'State, as near as you can, about what amount of stock was given for that patent."

(Question objected to by Mr. Wallace.)

A. "I do not know anything at all relating to the purchase of the Mellier patent."

20. Q. "Who would know who is connected with your company?"

A. "The officers of the company, I suppose."

21. Q. "When did you last boil pine or other woods containing resinous matter in caustic alkali of a strength of ten to twelve degrees English hydrometer, in the process of making pulp?"

(Question objected to.)

A. "I am unable to answer that question."

22. Q. "State, as near as you can, when you last used, in practical operation, that degree of the hydrometer in treating resinous woods in caustic alkali?"

(Question objected to by Mr. Wallace.)

A. "I think in 1862 or 1863 we boiled some lots of pine with weak alkali. I cannot remember the exact strength. I only know about that time I boiled some in weak alkali, but of what strength I do not now know."

23. Q. "Did it make pulp by boiling it in this alkali?"

A. "I do not remember the precise condition in which the wood came from the boiler."

24. Q. "When did you last boil resinous wood in caustic
528 alkali, and then submit it to the action of chlorine, or its compounds, with oxygen, and then to a weak solution of caustic alkali, and, fourthly, bleach it by the ordinary method of bleaching?"

A. "In the spring of this year (1867) we treated resinous wood in this manner, using hypochlorite of lime in place of bleach-powder. It may have been done since then, but not to my knowledge."

25. Q. "What amount of wood have you treated in that way, by submitting it to those four operations in succession?"

A. "Only a small proportion of the quantity used by us, perhaps from four to six per cent.; somewhere about there."

26. Q. "Has the bulk of resinous wood treated by you been pulped by boiling in caustic alkali alone? and if so, at what pressure and strength of solution by the English hydrometer? I mean at your works in practical operation in this country."

A. "The greater bulk of resinous wood has been pulped by boiling in caustic alkali, at a pressure from one hundred and forty to one

hundred and sixty pounds, at seventeen English hydrometer. This varies with the age of the wood, young wood requiring less strength."

27. Q. "What percentage of resinous wood do you mean by greater bulk, and what wood have you found to resist boiling in caustic alkali alone?"

A. "The percentage would be from ninety-four to ninety-six per cent. of resinous wood. I do not, at the present moment, remember any wood that will not pulp if sufficient pressure, time and alkalies are given to it."

28. Q. "What kind of wood is this four to six per cent. of wood, to which you have alluded, aud how does it differ from the other resinous wood?"

A. "The wood alluded to as being part of the four to six per cent., was mostly old resinous wood—hemlock and pine, and some little cedar, and also a small proportion of non-resinous wood, as poplar, gum, hickory and walnut."

29. Q. "Why did you have to submit these woods to the three stage process? Was it because, after pulping them and bleaching them in the usual way, you found the color not good. Did you boil them in caustic alkali under pressure, and bleach them a second time?"

A. "In some cases this was so; in others we could not pro-
529 perly prepare the pulp except by the three-stage process. By prepare, I mean render the pulp sufficiently soft and pliable."

30. Q. "How often did that occur, and where last, and with what wood?"

A. "Latterly, but very seldom, as we avoided using the woods that entail this process, these woods being very old resinous woods, as pine, cedar, and hemlock, or slow-growing hickory and walnut."

31. Q. "What percentage of resinous wood have you, in your practice, found to demand the tri-stage process?"

A. "I am unable to give a definite answer to that question; but the quantity of resinous wood so treated might be about one to two per cent. of all the resinous wood treated by us."

32. Q. "Are you willing to state positively that since 1856 you have boiled resinous woods in a solution of caustic alkali as low as twelve degrees, English hydrometer, and then treated it with chlorine, or its compounds, with oxygen, and then with a weak solution of warm caustic alkali, so as to pulp it, prior to bleaching."

(Question objected to by Mr. Wallace.)

A. "I believe we have only done this in one or two instances since 1856."

33. Q. "When, and to what extent, and why was it so done?"

A. "I cannot give the time. I do not think we have used this process more than two or three times. I forget the precise object for which this was done. I merely recollect its being done."

34. Q. "Then, in practice, the treatment of resinous woods as described in my last question has been abandoned by you in your practical operations since 1854? My question refers to the condition

of the caustic alkali and the subsequent treatments as mentioned in my thirty-second question."

(Question objected to by Mr. Wallace.)

A. "If you refer to the strength of the alkali as low as twelve degrees English hydrometer, it has been practically abandoned by us since 1854."

35. Q. "Has not your practice been to boil resinous woods in caustic alkali as strong, or stronger, than non-resinous woods, and in ninety-eight per cent. of the cases to pulp it by the direct action of caustic alkali?"

Question objected to by Mr. Wallace.)

A. "It has."

530 36. Q. "With non-resinous woods have you resorted, in practice since 1854, to this process, mentioned in my thirty-second question?"

A. "Only very seldom."

37. Q. "And has it been practically abandoned since 1854 in reference to non-resinous woods? I mean the process as set out in my thirty-second question."

A. "It has been practically abandoned, because we endeavor to discard those non-resinous woods requiring the tri-stage process."

38. Q. "Have you ever, since 1854, treated non-resinous woods as mentioned in the thirty-second question?"

A. "I do not remember having treated non-resinous woods in the process referred to, since 1854, more than once or twice at a strength of alkali as low as twelve degrees English hydrometer."

39. Q. "What is the minimum strength of alkali used by you since 1856 in your practical operations?

A. "About fourteen degrees English hydrometer for non-resinous, and about seventeen to eighteen for resinous."

40. Q. "In practical operation will a strength of twelve degrees English hydrometer be sufficient for resinous woods, by the single process?"

A. "With young resinous woods under a pressure of, say from one hundred and sixty to one hundred and eighty pounds, a pulp will be produced, but it would not be a pure pulp."

41. Q. "What would be the effect of treating resinous woods, of the ordinary character, at twelve degrees English hydrometer, and at three hundred degrees temperature? Would it pulp it? and if so, to what extent?

A. "A rough pulp, but not a pure pulp, would be obtained after long boiling?"

42. Q. "How long."

A. "From sixteen to eighteen hours, perhaps."

43. Q. "Would the pulp produced be such a result as your patent contemplates?"

A. "Not unless followed by the three-stage process."

44. Q. "Then boiling resinous woods in caustic alkali under pressure, at a temperature of three hundred degrees, and a strength of twelve degrees English, would not be within your invention, if not

subsequently treated by chlorine and a dilute solution of caustic alkali?"

531 (Question objected to by Mr. Wallace.)

A. "No, I do not think it would."

45. Q. "In boiling non-resinous woods, what is the minimum strength of alkali, English hydrometer, which must be used at three hundred degrees of temperature to produce the result which your invention contemplates? I mean what you call good pulp."

A. "With very young wood, perhaps a strength of seventeen degrees, English hydrometer, would produce a pulp contemplated in my invention, at a temperature of three hundred degrees, provided a large quantity of the alkaline solution was used."

HUGH BURGESS.

Sworn and subscribed before me this twenty-eight day of May, A. D. 1867.

CHAS. SERGEANT, *U. S. Commr.*

I herewith respectfully return to the court the testimony taken before me within entitled cause, together with exhibits produced in evidence before me, and hereto appended. September, 18, 1867.

CHAS. SERGEANT, *U. S. Commissioner.*

532 *Exhibit* 63, *C. S., U. S. Commissioner.*

Dumas.—Traité de Chimie Applique. Paris, 1843, vol. 5, p. 11.

Finally, if we wish to extract the cellulose of woods, the mechanical division necessary to open most of the woody cells can be obtained by first reducing the wood to powder by the action of a file, then grinding the powder obtained with water, with a muller on a slab of porphyry or granite.

We then treat in an oil bath the pasty substance, diffused in four or five times its weight of a solution containing about one-tenth of caustic soda or potash; we evaporate it to dryness, keeping its temperature up to the boiling point of the liquid, but avoiding at the end to push it to the point where a disengagement of hydrogen would take place.

We extract it with boiling water, treat it with chlorine or a solution of chloride of lime, wash it with dilute chlorohydric acid, then we reiterate the same treatment once, or even twice, if the woods are strongly incrusted.

We can, relatively to most of them, suppress the action of the chlorine, but this agent has appeared indispensable to extract pure the vegetable fibre of the wood of the coniferous trees.

The tissues of these woods presents besides several notable peculiarities: thus, the nitrogenous matter which penetrated into their thickness renders them capable of being colored yellow by iodine, remains there even after three treatments by potash, and not eliminated easily, except after the reaction of the chlorine.

Exhibit LXV. C. S., U. S. Commissioner.

3381 S'agit—il enfin d'extraire la cellulose des bois, la division mécanique nécessaire pour ouvrir la pulpart des cellules ligneuses peut s'obtenir en réduisant d'abord les bois en poudre par l'action d'une lime, puis bryant la poudre obtenue avec de l'eau, à la molette, sur en etable de porphyre ou de granit.

On chauffe alors au brain d'huile la substance pâteuse, délayée dans quatre ou cinq fois son poids d'une solution contentant environ un dixiéme de soude ou de potasse caustique ; on fait évaporer à
533 siccité, en soutenant la température au degré de l'ébulliton du liquide, mais évitant à la fin de pou-ser au point ori un dégagement d'hydrogéne aurait lieu.

On épuise à l'eau bouillante, on traite par le chlore ou par une solution de chlorure de chaux, on lave par l'acide chlorhydrique étendu puis on réitère une ou même deux fois le même traitement, si les bois sont fortement incrustés. On peut relativement à la plupart d'entre eux supprimer l'action du chlore, mais cet agent a paru indispensable pour extraire pure la fibre végétable du bois des conifères.

Des membranes de ces bois offrent d'aillerces plusieurs particularités notables; ainsi la matère aboté qui pénètre dans leur épasseur les rend colorable in jaume souci par l'iode, peuiste même après troit traitement à la pottasse et n'ent est éliminée facilement qu' après la réaction du chlore.

Defendant's Exhibit.

"Burgess' Note-Book," 1854 produced by Burgess and made Exhibit of at defendant's request.

Pulping Wood.

PHILADELPHIA, *August 20th*, 1854.

A. Boiled white pine sawdust in NaO. of 30° of Beaumé for about five hours. All taste was taken from the wood, and was easily separated by the fingers. The solution of soda after boiling was 30° Beaumé. The sawdust gased by the hot soda process pulped readily.

NOTE.—As long as the centres of pieces of sawdust remain of a dark color, perfect pulping will not follow.

B. Boiled 1280 grains of fine white pine sawdust in NaO. 22° Beaumé, for about five hours. 310 grains. Loss for boiling, 970 grains=76 per cent.

960 sawdust. Water 13 Loss by boiling.
After drying 835 63 per cent.
125

534 C. To determine the increase of weight of wood by gasing

	(1)	(2.)
Flask and charge,	895 grains	894
flask,	695 dry sawdust after	694
	200 boiling in Na O.	200

(B.)

Flask and charge,	1685	1299
flask,	695	694
	990 damp sawdust.	605

After gasing.

Flask and charge,	1875	1685
	1685	1521
	190 weight of chlorine.	164

After gasing and drying 190 grains.

To determine whether there be any variation in the time necessary to gas sawdust by cl. made by manganese, or from Na O. NO. 5, and Na cl. and SO. 3.

Took 12°° of white pine sawdust boiled in Na O. 30° Beaume.

1800″ salt. 132 gallons of 80 oz. at 55. 2500 of H. Cl. at 21 Beaume. 11 jars, 1 gallon, 40 of the two first, 2 gallons of the next 6.

Loss of water in sawdust, &c., &c.

(A.) Fresh from the mill, wood just out of the water; 1 degree= lost, $6\frac{1}{2}$° 3 = 40 per cent. water.

(E.) 20° sawdust lost, 9″. = 45 per cent. water.

(f.) 1″ of sawdust boiled to a pulp, gased pulp, $14\frac{1}{2}$° 3 or a loss of = 9-40 per cent. Bleached could detect no loss.

(f 2.) Of sawdust took $\frac{1}{2}$ $\frac{S\ O_3}{H.\ Cl.}$ $\frac{1}{2}$ } pulped and bleached = 14 oz.

(g 1.) The acid from 4 oz. of red stock saturated with waste. Ca +02 gased 1 oz. of brown stock, plenty of gas.

(g 2.) The acid from 3 oz. of red stock saturated with Ca O. 2, as above gased; 3 oz. of brown stock. This was done by adding as much Ca O. by Co. 2 from the alkali tub as would saturate the H. cl. then washed and pressed.

535

Caustic soda.—(See forward.)

10″ of soda ash of 51.5
$4\frac{1}{2}$ 6″ of lime.
$1\frac{1}{2}$ 3 gallons water. } = Caustic soda 22° Beaume, 1,180.

300″ soda.
200″ lime.
200 gallons water. } = 18 Beaume, slight.

100 soda.
29 gallons of H. O. } = 35 Beaume. This is the sort of saturation.

100″ lime.
8 gallons of H. O. } = Makes hydrate.

(h.) 200″ of raw stock boiled to a fair pulp, lost = 132″, or 66 per cent.

(i.) 40 gallons of black alkali, 5 Beaume, evaporated to dryness. = 13″ black ash by 4 gallons of H. O. 26 Beaume, 60°, when brought to 10 Beaume = 10 gallons = 10° soda ash.

(i 2.) Repeated the above, obtained 12″, 6 residue, there was a slight loss in the boiling, this batch. = 20½ gallons caustic 5 Beaume.

(i 3.) Repeated the above with 40 gallons of alkali of 6 Beaume from boiling H. = 19″ reduced to 10 Beaume = 18¼ gallons. There was some loss by boiling over in this experiment.

(k.) 2½ oz. of common rosin took 5½ oz. of caustic alkali of 15 Beaume to neutralize it.

(l.) A solution of caustic alkali of 3 Beaume 170° = on the addition some rosin remained at 3 Beaume 170°.

(m.) 10 gallons of alkali at 9 Beaume = 11¼ soda-ash considerable Co. 2 was boiled with 20″ raw stock for some hours, and it evaporated to dryness with the stock 2″. Rosin added to neutralize the caustic soda left 11″ + 10 gallons, HO 10 Beaume, 60° 8″ lime was added = 16.5 Beaume soda-ash.

Proportions salt cake, 225.
Small coal, 130.
Lime carb., 250.

The ash should come out of the reverberatory furnace of gray color. If it contains too much soluble sulphuret of calcium more chalk is necessary, as the sub-sulphuret is insoluble in water.

536 (n 1.) 8 gallons of nearly caustic alkali of 13 Beaume evaporated to dryness = 8″.

(n 2.) 8 gallons of caustic alkali of 7 Beaume = evaporated 4¼″.

(o 1.) Acid manganese. 2 oz. 1 oz. } Gased in H. O. Not finished too much. Escape of gas from water bottle.

(o 2.) Acid manganese. 2 oz. 21 Be., 11° S O, 1 oz. } Gased 6/4. } oz. 10 of brown stock. Pulped. Yielded = 3 oz. dry.

Gravities of Alkali.

Tempt.	Gravity. Beaume.	Tempt.	Gravity. Beaume.	Bushel Lime = 66″. Average on mixtures of alkalies.
54		72	30	Alkali, 31 Be. + Equal parts
62	16½	60	29½	of water at 0° Be. = 19 Be.
189	16½	170	33	Alkali, 22 Be., + equal parts of
77	17½	60	33	water = 12 Be.
60	21½			Alkali, 31⅓ Be., + equal parts of
160	22			alkali. 19 Be. = 25½ Be.
80	15			Alkali, 31½ Be. Equal parts of
216	19			alkali. 9 Be, = 22 Be.
60	21			1½″ of soda caustic, in 2 gallans
120	25			of water = 6 Be., 70°.
60	17	Used on charge of		1½ of soda-ash in two gallons of
140	19½	wood.		water = 8 Be., 60°.
60	28			10″ soda-ash. } = Solution of soda-water of
	28			10 galls. of H. O. } 10 Be., 60°.

Alkali experiments.

4 gallons of H. O. + 18″ soda-ash = 35 Beaume.

The point of saturation of soda-ash is 35 Beaume, at 90° as it cooled were formed, but the gravity was the ssme.

10″ soda-ash,
10″ lime,
10 gallons of water. } = Caustic soda = 16 Beaume.

10″ soda,
10″ lime,
6 gals. HO. { Soda not quite caustic. The lime was slaked of this H. O. There was also some evaporation. } = 20° Be., 60° + 6 galls. of H. O. = soda caustic of 9 Be. 6½ galls. = 17 galls. 5 of Be. caustic.

100″ soda,
200″ lime,
50 gallons. } = 18 Beaume; not caustic + 35 gallons 5 of Beaume, caustic = 13 not caustic; not finished.

537 100 soda.
200 lime, made into milk of lime.
68 gallons of water—28 gallons added to the lime.
40 " " " "

Boiling and gasing, December 7, 1954. (A.)

Wood, 260″, containing 40 per cent. water.

Alkali, 70 gallons, 17 Beaume. 120° contained a good deal of c c 2. Boiled 9 hours to a fair pulp.

Alkali, after boiling, 11 Beaume, and still caustic.

Gasing, 166 salt. There was too much gas, stock gased pale yellow.

Boiling account, F.

Stock, 200.

Alkali, 58 gallons, 3 Beaume. This did hardly any good, + 20 gallons of 11 Beaume, caustic. Boiled some hours. Stock soft; not pulped; soda very slightly caustic. This was again boiled in about 50 gallons of 12 Beaume, not very well pulped.

Boiling account, G.

Stock, 200″.

Alkali, 40–4, Beaume. } Beaume, 51 gallons of 7 Beaume, alkali
" 11–12, Beaume. } came on.

5 Braume, and not at all caustic, by 60 gallons of 13 Beaume = 111 c 10¼ Beame. Boiled for four hours. This charge was boiled to a good pulp. The solution was very caustic. The combined alkalies = 5 Beaume, 200 gallons.

Boiling gasing account, B.

Wood, 250″.

Alkali, 70 gallons; 60°, 25 Beaume; much CO 2 after boiling: 11 Beaume; slightly caustic; the stock soft, but not pulped; gasing, 240; salt stock; gased red; too much gas.

Boiling, H.

200″ dry stock, (40 per cent. water in the virginal stock = 335 of wet stock.

60 gallons alkali, 13 Beaume; boiled 5 hours; stock soft; not pulped; alkali quite neutralized + 60 gallons of 9 Beaume;
538 boiled 5 hours; alkali neutralized × 50 gallons of alkali, 13 Beaume—stock pulped in three hours, alkali very caustic = 8 Beaume—washing the stock in the press and the old alkali in the stock in the boiler, brought the alkali down to 5 Beaume = 96 gallons.

NOTE.—These 96 gallons were made up of the neutralized alkali in the stock, the condensation and the new alkali.—Vide l 3.

Paper boiling account, (C.)

Wood, 60″

Alkali, 20 gallons, nearly caustic, 11½ Beaumé, 160°.

This experiment was spoiled for want of steam pressure, (pipe burst.)

Boiling account, E.

Stock, 200″

Alkali 60 gallons, 13 Beaumé, 60° very nearly caustic, boiled 9 hours, stock loose, but not pulped; added 48 gallons of 8 Beaumé, boiled 8 hours.

Stock soft but not quite pulped, if blown out with a head of steam would have pulped.

120″ salt stock gased redish. Not quite finished; boxes very solid; stock frozen.

Paper boiling account, D.

Stock, 250″

Soda, 100″ }
Lime, 100 } Mixed in the boiler, the mile of lime and the solution of soda. The stock was boiled 14 hours; was not pulped. The soda was but little carbonated on drawing, and still slightly caustic.

Boiling 1.

Stock, 250.

Alkali, 80 gallons of 8 Beaumé, boiled about 2½ hours; stock very soft, alkali neutralized = 6 Beaumé + 50 gallons of 6 Beaumé, boiled 8 hours, stock nearly pulped = Alkali neutralized = 4 Beaumé.

Boiling.

April 29, 83 bundles of straw = 12 bundles weighed 186″ = 15½ each. Stock quite done, 3 hours at 75 prs.

539 Straw not quite done; Bek. liquor, 5 Beaumé, boiled 5 hours.

The stock not done; second boiling finished the charge.

The charge not done; second boiling finished the charge.

The liquor was not quite caustic. The straw was not entirely pulped, a few strings being left, but these quite soft.

8 bales of straw about 200″ a piece. The liquor was not caustic. Not finished by first charge. Finished by second boiling.

Stock was not quite done. The alkali still caustic. Some of the thick pieces being still hard.

Charge quite done. Rope was well mixed throughout.

540 *Defendant's Exhibit No.* 1.—*Record book of Henry Burgess.*

(Boiling account.)

Date. 1856.	Stock.	Kind.	Alkali, Gallons.	Hydro. Beaume.	Pounds of Soda-Ash.	Remarks.
April 29	1286	Straw	700	8½	371	
" 30	3244	Maple	1150	11	1582	Done 3 hours at 175.
May 1	1260	Straw	500	10	625	Not done.
" 2	2970	Maple	1000	10	1251	Not done first boiling.
			500	11	687	
" 5	3128	Poplar	1500	11	2063	
" 9	1230	Straw	750	10	937	
" 11	1600	"	950	11	1305	
" 12	4326	Poplar	1250	7	1094	Not done first boiling.
	658	Straw	600	5	374	
	4984		1800			
" 17	4369	Poplar				
	525	Straw				
	4894	1	1550	9	1743	Done.
" 19	4336	Hickory	1610	10	2000	Done.
	525	Straw				
	4861					
" 19	4389	Poplar	1300	11	1788	Charge well done.
	500	Rope	500	7	437	
	4889		1800			
" 22	3514	Poplar				
	525	Straw	1800	7	1236	
	4039					
" 22	1200	Straw	1200	11		[would not bleach.
June 26	1980	Cedar	1450	8	1450	Boiled 24 hours;
" 27	2569	Cedar	550	8	550	Not quite done; would not bleach.
		Rail	750	6		
			475	8	475	
" 28	1700	Flax	800	7		Shire not done.

Defendant's Exhibit No. 1—Continued.

Date. 1856.	Stock.	Kind.	Alkali, gallons.	Hydro. Beaume.	Pounds of soda ash.	Remarks.
July 1	3465	Poplar	550	6	412	Shire not done.
	494	Flax	2300	7	2012	
541	3959		2850		2424	
" 2	5678	Poplar	1350	9	1518	
			500	10	625	This charge was water-logged, and the liquor was discharged and fresh put in.
			800	5	497	
			500	10	675	
					625	
					3940	
" 5	6482	Poplar	700	10	875	
			450	9	281	
			1850	10	2312	
					3468	
" 7	4919	Poplar	1950	10	2437	
	500	Rope				Well done.
	5419					
" 10	1990	Flax	1000	10	1250	Overdone.
" 11	3000	Cedar	2000	10	2500	Overdone.
" 14	1137	Straw	600	11	824	Well done.
" 14	1400	"	1050	10	1313	
	846	Poplar				Well done.
	2240					
" 15	4133	Poplar	1400	10	1750	
	700	Straw	150	8	150	Not done; nearly all black ash.
	4834				1900	Liquor.
" 17	500	Rope	850	10	1062	Charge well done.
	540	Straw				
	1040					
" 18	3976	Poplar				
	600	Straw	1650	8	1650	Not quite done, liquor exhausted.
	150	Rope				
	4726					
" 19	3181	Poplar	1200	12	1794	
	300	Rope	175	9		Well done except end chips.
	555	Straw				
	4036					

Defendadt's Exhibit No. 1—Continued.

Date. 1856.	Stock.	Kind.	Alkali, gals.	Hydro. Beaume.	Pounds of soda ash.	Proportion.	Remarks.
July 19	1316	Poplar					
	200	Rope	1000	9	1125		Well done.
	720	Straw					
	2236						
" 21	1360	Straw	650	10	812		(Black ash.)
	170	Rope	175	7	113		Well done, liquor not quite exhausted.
	1530				925		
542 22	1300	Straw					
	170	Rope	325	12	487		Well done.
July 23	4600	Dry pep.					
	210	R'e & f'x.	750	10	937		Not done; liquor exhausted; added fresh liquor; all done but shire and knots.
	375	Straw	750	10	937		
	5185				1874		
" 23	1300	Straw					
	250	Flax	450	10	409		Shire not done; reboiled on 24th.
	1550						
	Above charge.						
" 24	1080	Straw	300	10	375		Shire not done.
" 25	1525	"	300	10	375		Not quite done.
" 25	1260	"	300	10	375		Done.
" 25	1170	"	500	8	500		Done.
" 25	2373	"	950	8	950		Charge done in three hours.
" 28	3005	"	325	5	202		
	200	Rope	275	8	275		
			500		218		Not quite done.
	3205		175	10	187		
" 28	1493	Straw	425	10	531		Done.
" 29	3085	Poplar	525	10	656		
	200	Rope					About $1\frac{1}{4}$" well done.
	3285		576	11	789		
" 30	3173	Poplar	700	11	962		
	200	Rope	150	3	55		Pulp, none allowed for rope; boiled 15 hours; well done; rope overboiled.
			150	3	55		
	3373		250	11	343		
					1415		

Defendant's Exhibit No. 1.—Continued.

Date. 1856.	Stock.	Kind.	Alkali, gals.	Hydro. Beaume.	Pounds of soda ash.	Proportion.	Remarks.
July 30	3430	Poplar	600	12	900		About 1⅓″ to 1″ wood pulp; liquor good; stock well done.
		Rope	640	6	487		
			250	7	218		
	3580				1605		
" 31	3395	Poplar	950	10	1187		Well done 1″ to 1″ of wood pulp.
	150	Rope			and some weak heading liquor.		
	3545						
Aug. 2	3598	Poplar	1100	8	1100		Not quite 1″ to 1″ pulp; well done; liquor good.
	784	Straw	150	3	75		
	4382		20	1	125		
					1300		
543 3	1450	Rope	1500	1	187		Liquor exhausted; shire not done; reboiled Aug. 9.
			8				
Aug. 4	5232	Poplar	850	9	955		Liquor good; well done; not at 1″ to 1″ of pulp.
			350	12	480		
					1435		
" 5	3465	"	550	11	825		Not 1″ to 1″ of pulp well done.
			200	4	100		
					925		
" 6	5264	"	650	12	975		(Not caustic.) A few black specks of undone stock; not a good head of steam.
			325	10	406		
			300	6	225		
					1606		
" 8	1918	Bass	375	11	514		Well done.
" 8	4473	Poplar	550		687		Well done.
			600		374		
					1061		
544 8	2625	Poplar	500	750	750		Liquor exhausted; well done.
			Hdg. Liq'r.				
Aug. 8	4625	"	500	12	750		Liquor good; well done.
			Hdg. Lq'r.				
			50	12	75		
					825		
" 9		Rope reboiled.	100	9	112		
" 11	5292	Poplar	1050	9	1181		Well done.
			600	9	674		
					1855		

Defendant's Exhibit No. 1.—Continued.

Date. 1856.	Stock.	Kind.	Alkali. Gals.	Hydro. Beaume.	Pounds of Soda-Ash.	Proportion.	Remarks.
Aug. 11	2884	Poplar	700	9	787		Liquor exhausted; reboiled.
			350	4	125		
			150	10	187		
" 12	1917	Flax	700	10			Not done by 1st or 2d liquor; by 3d liquor the flax was hot; the shire not done.
			375	12			
" 13	1890	Straw	750	12			Not done by first quantity; B. A. was the ash used.
" 15	1500	Rope	375	12			Not done by first liquor.
" 16	5768	Poplar	1850	12			Well done.
" 18	1685	Straw	900	7			Well done.
	344		150	12			
	2029						
" 18	2128	Poplar	700	12			Well done.
	1683	Straw	850	12			
	3811						
" 19	4957	"	700	12		15	Not done by first quantity of liquor; not done by 2d; this was in No. 2 boiled.
			600	10			
			250	10			
" 19	2203	"	800	10		15	Not done by 1st quantity of liquor; added fresh ch'ge of straw; not done; 3d liquor finished the charge.
	1376	"	600	10		13	
	3579		600	6			
" 19	3584	Poplar	1750	11			An error was made in the calculation of the wood; too much alkali.
			200	14 N. C.		13	
545 21	4000 undone straw.	"	1501	12			Allowance made for undone straw; liquor quite good.
Aug. 22	3138	Straw	550	14 N. C.			Allowance made for rope, liq'r good.
	100	Rope	550	12		13	
	3208						

Defendant's Exhibit No. 1.—Continued.

Date. 1856.		Stock.	Kind.	Alkali. Gals.	Hydro. Beaume.	Pounds of Soda-Ash.	Proportion.	Remarks.
"	22	1217	Rope	400	8		17	Well done; the hdg liq'r was good.
				Hdg. Liquor. S.				
Aug.	23	5040	Poplar	750	8		11¼	Allowance made for N. C liquor; well done; liquor good, but strong.
		862	Straw	1950	11	N. C.		
		5902						
"	23	1680	Poplar	750	10		11	Well done.
		1416	Straw	900	7			
		3096						
"	25	2000	Poplar	950	12		12¼	Well done.
		1923	Straw	500	10			
		3923						
"	26	4400	Poplar	700	10		12	Well done.
		1064	Straw	1200	13			
		5464						
"	27	2000	Poplar	850	8		12	Well done; liquor exhausted.
		2017	Straw	900	11			
		4017						
"	28	2000	Poplar	1200	12	B. A.	9	Well done; liquor quite good.
		2066	Straw	800	11			
		4066						
		(1)						
"	28	1000	Poplar	1550	9		12	Well done; liquor exhausted.
		2221	Straw					
		3221						
		(2)						
"	19	1000	Poplar	400	9		10	Well done; liquor good.
		3057	Straw	1300	13	B. A.		
		4067						
		(1)						
"	30	1344	Poplar	150	13	B. A.	16	Well done; liquor exhausted.
				550	8			
		1967	Straw	750	6			
		3311						
		(2)						
Sept.	1	3005	Straw	755	6			Well done.
		1344	Poplar	1050	10		13	
546				500	5			
		4349						

Defendant's Exhibit No. 1—Continued.

		(No. 1)						
Sept.	2	3478	Straw	1400	12	B.A.	11½	Well done.
		1344	Poplar	700	6			
		4822						
		(No 2)						
"	2	2902	Straw	750	7			Not done; weak liquors do not seem to be so effective, though the number of degrees may be made up.
		1000	Poplar	450	4			
		——		400	5			
		3902		550	12			Well done.
		(No. 1)						
"	3	3159	Straw	200	10			Well done.
		1120	Poplar	1250	12½	B.A	13¾	
		4279						
		(No. 5)						
"	4	3019	Straw	750	12			Well done; liquor exhausted.
				450	9			
				150	11			
"	5	3001	Straw	1350	11	B.A		Well done; liquor exhausted.
		214	"					
		3215						
"	6	2533	"	450	9			Well done; liquor exhausted.
				900	10			
"	8	3007	"	350	10			Well done; liquor exhausted.
				900	10			
"	9	3192	"	1200	11			Well done; liquor good.
				150	10			
"	9	3169	"	1200	10			Well done; liquor exhausted.
"	10	2994	"	750	7			Well done, liquor exhausted.
				1150	8½			
"	10	2102	"	1000	6			Well done; liquor exhausted.
				750	5			
"	10	3104	"	1000	9			Well done; liquor exhausted.
				450	10			
"	11	2185	"	1050	8			Well done; liquor exhausted.
				450	6			
"	12	2844	"	900	8½			Fairly done; liquor nearly exhausted.
				356	6			
				250	5			
"	13	1235		bl'k l'qr				Well done.
"	13	3459	"	900	11			Well done.
				700	6			

Defendant's Exhibit No. 1—Continued.

Sept. 15	3178	Straw	750	12	Well done.
			800	6	
" 15	2896	"	1050	11	Well done.
			450	6	
" 16	3073	"	650	6	Well done.
			1100	9	
" 16	2499	"	1050	9	Well done.
			200	9	
" 17	3084	"	1000	12	Well done.
			150	6	
" 17	2541	Straw	900	6	Well done.
	75	Bag	850	8	
" 18	2616	"	750	13	Well done.
	3307		550	5	
" 18	3128	"	650	5	Not done; added fresh liquor.
			500	13	
			500	6	
" 19	3150	"	1250	11	Well done.
			200	10	
" 19	3006		650	11	Not done; added fresh liquor.
			600	9	
Nov. 10	2800	"	1000	11	Well done.
" 11	2700	"	1200	10	Well done.
" 12	3355	"	1300	10	Well done.

548 1856.

Nov. 13, 3140, Bagging.
" " 3442, "
" 14, 3147, "
" 15, 2577, "
" " 2548, "
" 17, 2506, "
" " 2507, "
" " 2561, "
" 18, 2614, "
" " 2564, "
" " 2540, "
" 19, 2533, "
" " 3042, "
" " 3131, "
" " 3090, "
" 20, 3960, "
" " 3090, "
" " 3028, "
" 21, 3059, "
" " 3009, "

Nov. 22, 3030, Bagging.
" " 3100, "
" 24, 3084, "
" " 3034, "
" 25, 2595, "
" " 3074, "
" " 2503, "
" 25, 2573, "
" " 2519, "
" 27, 2589, "
" " 2538, "
" 28, 2 44, "
" " 2587, "
" " 2587, "
" 29, 2669, "
" " 2536, "
" " 2542, "
Dec. 1, 5089, "
" 2, 2524, "
" " 2598, "

1856.

Dec. 2, 2539, Bagging.
" " 2542, "
" 3, 2526, "
" " 2562, "
" " 2544, "
" " 2517, "
" 4, 2552, "
" " 2520, "
" 5, 2511, "
" " 2533, "
" 6, 2585, "
" " 2539, "
" " 2502, "
" 8, 2536, "
" " 2531, "
" " 2513, "
" " 2546, "
" 9, 2522, "
" " 2558, "
" " 2569, "
" 10, 2500, "
" " 2526, "
" " 2533, "
" 11, 2545, "
" " 2518, "
" 12, 2500, "
" 13, 2524, "
" " 2500, "
" 15, 2513, "
" " 2518, "
" " 2509, "
" 16, 2528, "
" " 2507, "
" " 2500, "
" 17, 2500, "
" " 2510, "
" " 2507, "
" 18, 2526, "
" " 2540, Straw.
" " 2519, "
" 19, 2500, "
" " 2513, "
" " 2539, "
" 20, 2513, "
" " 2554, "
" 22, 2504, "
" " 2508. "
" 23, 2569, "
" " 2513, "
" " 2533, "

1856.

Dec. 23, 2574, Straw.
" 24, 2516, "
" " 2550, "
" 27, 2571, "
" " 2534, "
" 29, 2505, "
" 30, 2534, "
" " 2558, "
" 31, 5558, "
" " 2531, "
" " 2528, "

1857.

Jan. 1, 2538 Straw.
" 2, 2562 "
" 3, 2553 "
549 3, 2556 "
Jan. 5, 2535 "
" 6, 2519 "
" 7, 472 Rag.
" 12, 865 "
" 13, 3054 Straw.
300 Rope.

3354

" 14, 3018 Straw.
300 Rope.

3318

" 14, 2505 Straw.
200 Rope.

2705

" 15, 3088 Straw.
200 Rope.

3288

" 15, 3041 Straw.
200 Rope.

3241

" 16, 3068 Straw.
200 Rope.

3268

" 16, 3026 Straw.
200 Rope.

3226

1856.

Jan. 19, 250 Rope: [old charge.]
" 20, 3060 Straw.
131
3191
" 20, 457 Rag.
" 21, 2500 Straw.
" 21, 650 Rag.
" 22, 2500 Straw.
" 22, 2500 "
" 23, 2500 "
" 24, 1696 Rag.
" 26, 2000 Straw.
" 30, 1185 Rope.
" 30, 2559 Straw.
" 30, 2553 "
" 31, 2552 "
" 31, 2578 "
Feb. 2, 6052 Straw.
" 3, 2595 "
" 4, 3042 "
" 4, 3006 "
" 5, 3000 "
" 6, 5590 "
" 9, 3005 "
" 10, 3082 "
" 10, 2500 "
" 11, 3000 "
118 Flax.
3118
" 12, 3000
122 Flax.
3122
" 13, 1572 Wood.
97 Bagging.
1669
" 14, 3000 Straw.
61 Flax.
3061
" 16, 3000 Straw.
97 Flax.
3097
" 16, 3000 Straw.

1856.

104 Flax.
3104
Feb. 17, 3000 Straw.
62 Flax.
3062
" 18, 3000 Straw.
200 Bagging.
3200
" 18, 3000 Straw.
200 Manilla.
3200
" 19, 3000
180 Rope.
1830
550 Jan. 19, 3000
180 Rope.
9180
Feb. 21, 3000 Straw.
200 Rope.
3200
" 24, 2500 Straw.
170 Rope.
2670
" 25, 2500 Straw.
170 Rope.
2670
" 26, 2500 Straw.
62 Bagging.
2562
" 27, 2500
42 Bagging.
2542
" 27, 2500
49 Bagging.
2549
" 28, 2500

1857.
280 Rope.
2780
Feb. 28, 2500
170 Rope.
2670
Mar. 2, 2500 Straw.
170 Rope.
2670
" 2, 2500 Straw.
170 Rope.
2670
" 2, 2500 Straw.
170 Rope.
2670
Mar. 3, 2500 Straw.
170 Rope.
2670
" 4, 2500 Straw.
170 Rope.
2670
" 4, 1225 Straw.
170 Rope.
1225 Wood.
2620
" 5, 1225 Straw.
1225 Wood.
170 Rope.
2620
" 5, 2500 Straw.
170 Rope.
2670
" 6, 2500
170
2670
" 6, 2500 Straw.
170 Rope.
2670

1857.
2500 Straw.
170 Rope.
2670
Mar. 7, 2500 Straw.
170 Rope.
2670
" 9, 2500 Straw.
170 Rope.
2670
" 9, 2500 Wheat.
170 Rope.
2670
" 10, 2500 Wet straw.
170 Rope.
2670
551 Mar. 10, 2500 Wet straw.
170
2670
Mar. 11, 2500 Wet straw.
170 Rope.
2670
" 11, 2500 Wet straw.
170 Rope.
" 12, 2500 Rag straw.
170 Rope.
2670
" 12, 2500 Straw.
170 Rope.
2670
" 13, 1323 Wood.
50 Rope.
1373
" 13, 2500 Straw.
170 Rope.
2670
" 13, 2500 Straw.

1857.
170 Rope.
2670
Mar. 14, 2500 Straw.
146 Rope.
2646
" 14, 900 Rag, Rogers.
" 14, 2500 Straw.
" 16, 2500 "
" 16, 2500 "
" 17, 2500 "
" 17, 2500 "
" 17, 2500 "
" 18, 2500 "
" 18, 2500 "
" 18, 1000 Rag, Rogers.
" 19, 2500 Straw.
300 Rope, M. Bed.
2800
" 19, 2500 Straw.
170 Rope.
2670
" 20, 2500 Straw.
170 Rope.
2670
" 20, 2500 Straw.
170 Rope.
2670
" 21, 2500 Straw.
170 Rope.
2670
" 21, 2500 Straw.
170 Rope.
2670
" 21, 2500 Straw.
170 Rope.
2670
" 23, 2500 Straw.
170 Rope.
2670

1857.
Mar. 23, 2500 Straw.
170 Rope.
2670
" 24, 2500 Straw.
170 Rope.
2670
" 24, 2500 Straw.
170 Rope.
2670
" 25, 2500 Straw.
170 Rope.
2570
" 25, 2500 Straw.
170 Rope.
2670
552 Mar. 26, 2500 Straw.
170 Rope.
2670
Mar. 26, 2500 Straw.
170 Rope.
2670
" 27, 2500 Straw.
170 Rope.
2670
" 27, 2600
170
2670
" 28, 2500 Straw.
170 Rope and bagging.
2670
" 28, 2500 Straw.
170 Rope and bagging.
2670
" 30, 2500 Straw.
170 Rope and bagging.
2670
" 30, 516 Cotton sweepings.

1857.

Apr. 1, 2500 Straw.
170 Rope.

4570

" 1, 2500 Straw.
170 Rope.

2670

" 2, 2500 Straw.
170 Rope.

2670

" 2, 2500 Straw.
170 Rope.

2670

" 3, 2500 Straw.
170 Rope.

2670

" 3, 523 Sweepings.

" 4, 2500 Straw.
170 Rope.

2670

" 6, 2500 Straw.
170 Rope.

2670

" 7, 2500 Straw.
170 Rope.

2670

" 7, 2500 Straw.
170 Rope.
170 Sweepings.

2840

" 8, 2500 Straw, part Oats.
100 Sweepings.
120 Rope.

2720

" 8, 2500 Oats and Straw.
100 Sweepings.
120 Rope.

2720

" 9, 2500 Oats.

1857.

100 Sweepings.
120 Rope.

2720

Apr. 9, 2500 Oats.
100 Sweepings.
120 Rope.

2720

" 10, 2500 Oats.
150 Sweepings.
80 Rope.

2730

" 10, 1870 Oats.
70 Rope.
140 Sweepings.

2080

553 11, 1360 Oats.
45 Rope.
95 Sweepings.

1500

Apr. 11, 2500 Oats.
40 Rope.
80 Sweepings.

2720

" 13, 2500 Oats.
60 Rope.
200 Sweepings.

2760

" 14, 2500 Oats.
60 Rope.
200 Sweepings.

2760

" 15, 2345 Poplar.
70 Rope.
200 Sweepings.

2615

794 Sweepings.

" 17, 865 Picker waste.

" 18, 1800 Red Cedar.
100 Rope.

1857.

100 Grass bag.

2008

Apr. 20, 2000 W. Cedar.
100 Rope.
100 Bagg.

2200

" 20, 1800 R. Cedar.
70 Rope.
100 Bagg.

1970

" 21, 2000 W. Cedar.
100 Rope.
100 Bagg.

2200

" 22, 2100 W. Cedar.
100 Rope.

1857.

100 Bagg.

2300

Apr. 23, 2500 Poplar.
200 Rope.

2700

" 24, 2500 Poplar.
200 Rope.

2700

" 25, 2500 Dirty straw.
200 Rope.

2700

" 25, 2500 Poplar.
200

2700

1859.	Straw.	Corn-stalk.	Rope.	Woolens.
Aug. 10,	1266	"	1420	"
" 12,	1373	"	"	"
" 15,	2729	"	"	"
" 18,	1233	"	2906	"
" 19,	1268	"	"	"
" 20,	3133	"	"	"
" 22,	"	"	"	4423
" 23,	2815	"	"	"
" 26,	2711	"	"	"
" 27,	3582	"	"	"
" 27,	2737	"	"	"
" 28,	3471	"	"	"
" 29,	2247	"	"	"
" 29,	1571	"	"	"
	31147	"	4326	4223
Sep. 1,	1381	"	"	"
" 1,	2354	"	"	"
" 2,	2182	"	"	"
" 3,	2677	"	"	"
			Flax.	
" 6,	1062	"	2000	"
" 7,	3665	2721	"	"
" 10,	1461	803	"	2102
" 11,	1377	"	"	2634
" 12,	6466	"	"	3857
" 13,	2584	"	"	"

1859.	Straw.	Corn-stalk.	Rope.	Woolens.
Sept. 14,	5350	"	"	"
" 17,	4726	"	"	2709
" 19,	1359	"	"	"
" 20,	5726	"	"	"
" 21,	6393	"	"	"
" 26,	"	"	"	5004
" 26,	"	"	"	4751
" 29,	"	"	1766	"
" 29,	"	"	3365	"
" 26,	1091	"	3341	"
" 30,	2721	"	"	"
	54575	3523	10472	21057
Oct. 3,	2374	"	"	4163
" 4,	1835	"	"	3199
" 5,	2311	"	4992	"
" 6,	2489	"	3163	"
" 6,	2222	"	"	"
" 10,	3113	"	"	"
" 11,	2337	"	"	"
" 12,	1873	"	"	"
" 12,	2912	"	"	"
			R.	
" 13,	2324	"	3137	"
" 14,	2268	"	"	"
			R.	
" 15,	2304	"	5869	"

1859.	Straw.	Corn-stalk.	Rope.	Woolens.
Oct. 17,	1926	"	"	"
" 18,	2703	"	"	"
" 18,	2599	"	"	"
" 19,	4491	"	"	"
			Mlla.	
" 19,	1444	2000	3704	"
			R.	
" 19,	1301	"	4691	"
" 20,	"	"	"	"
	G.		Bagg.	
" 22,	2516	2291	2291	"
" 25,	1135	"	"	"
" 25,	2260	1000	"	"
" 25,	1368	"	"	"
" 25,	1436	"	"	"
" 26,	2360	"	"	"
" 26,	2076	"	"	"
" 27,	1259	"	4329	"
" 27,	1197	"	"	"
" 31,	1240	"	"	"
" 31,	1142	"	"	"
	59851	5292	1376	7362
Nov. 2,	1234	"	"	5191
" 2,	1229	"	"	"
			Mlla.	
" 3,	1188	"	4304	"
" 4,	1387	"	"	"
" 7,	"	"	4353	"
" 8,	4128	"	"	3322
			Mlla.	
" 10,	"	"	2900	"
			Bgg.	
" 12,	1958	"	1910	"
			Mlla.	
" 21,	"	"	3073	"
" 21,	"	"	2540	"
			C. B.	
" 22,	1697	"	1295	"

1859.	Straw.	Corn-stalk.	Rope.	Woolens
			C. B.	
Nov. 23,	1650	"	3037	"
			C. B.	
			3315	
	14441		26727	8514
	S. Hay.		M.	
Dec. 5,	3980		3080	
			M.	
" 5,	1993		3060	
			M.	
" 6,	1082		3112	
			G. B.	
" 8,	1370		3268	
			M.	
" 9,	3250		3011	
			M.	
" 44,	7972		3095	
			G.	
" 17,	1953		2926	
			M.	
" 20,	1338		3094	
	S. H.		Ta. Rope.	
555 21,	2288		2977	
			G.	
" 21,	1131		2042	
	S. H.		M.	
" 21,	2308		3130	
	S. H.		G. B.	
" 21,	2308		3130	
			G. B.	
" 23,	2962		3173	
			G.	
" 23,	2648		3030	
	S. H.		M.	
" 27,	8120		5091	
			Td. Shrs.	
" 27,			4030	
			M.	
" 29,			4077	
			M.	
" 30,			1293	
			Ta. Rope.	
" 31.			1909	
	44703		56483	

556 In the Circuit Court of the United States for the eastern district of Pennsylvania.

THE AMERICAN WOOD PAPER COMPANY
vs.
JACOB D. HEFT, S. A. RUDOLPH, AND JOHN W. DIXON. } In equity.

To the judges of the Circuit Court of the United States for the eastern district of Pennsylvania:

The American Wood Paper Company, a corporation created by the legislature of the State of Rhode Island, and located and
557 transacting business at Providence, in said State, a citizen of

the State of Rhode Island, bring this their supplemental bill of complaint against Jacob D. Heft, S. A. Rudolph, and John W. Dixon, of Philadelphia, in the eastern district of Pennsylvania, and State of Pennsylvania.

And thereupon your orators complain and say, that on the twenty-ninth day of August, A. D. 1865, they filed their original bill of complaint in this court against the said Jacob D. Heft, S. A. Rudolph, and John W. Dixon, alleging, among other things, that your orators were the owners, by certain mense assignments of certain letters patent of the United States, granted on the eighteenth day of July, A. D. 1854, ante-dating the nineteenth day of August, A. D. 1853, to one Charles Watt and one Hugh Burgess, of London, England, for a new and useful improvement in the manufacture of paper from wood, for the term of fourteen years from the said nineteenth day of August, A. D. 1853, which letters patent had been surrendered by William F. Ladd and Morris L. Keen, assignees of the same, and new letters patent issued thereupon on the fifth day of October, A. D. 1858, to the said Ladd and Keen, and which said reissued letters patent were again surrendered by the said Ladd and Keen, and reissued to them in two parts on the seventh day of April, A. D. 1863, on two corrected
558 specifications duly made and filed—one for the improved process of treating wood and other vegetable substances in the manufacture of paper pulp, and the other for an improved pulp from wood or other vegetable substances for the manufacture of paper—each of which said last-named letters patent were issued for the residue of the then unexpired term of said original letters patent; that is to say, for the term of fourteen years from said nineteenth day of August, A. D. 1853, and were subsequently duly assigned by the said Ladd and Keen to your orators, as set forth in said original bill; and further alleging that the said Jacob D. Heft, S. A. Rudolph, and John W. Dixon, defendant, in said original bill, had infringed the rights of your orators, as the owners of said reissued letters patent, by wrongfully manufacturing and using, or vending to others to be used, large quantities of paper and paper pulp, manufactured in accordance with the description set forth, and by means of the processes and machinery described in the specifications annexed to said reissued letters patent, numbered 1,448 and 1,449, during the said original term of said letters patent, as in said original bill set forth, reference to which is hereby had, and which is made a part of this supplemental bill of complaint.

And your orators further state that since the filing of said origina bill of complaint, and after the defendants had answered the same, and replication had been filed thereto, and testimony taken therein on the question of the said alleged infringement of said reissued letters patent, your orators, by an instrument in writing, a copy
559 of which is hereto annexed, marked A, conveyed to Charles Watt and Hugh Burgess, the original inventors and patentees as aforesaid, all the right, title, and interest of your orators in said reissued letters patent; that thereupon the said Charles Watt and Hugh Burgess filed on the day of , A. D. 1867, with the

Commissioner of Patents of the United States, applications for the extension of said letters patent for the further term of seven years from and after the nineteenth day of August, A. D. 1867, and paid the fees required by law thereon; that thereupon proceedings were had, as required by law and the rules and directions for proceedings in the Patent Office, which resulted in the grant of an extension of said reissued letters patent for the further term of seven years from said nineteenth day of August, A. D. 1867, as will appear by reference to the certificate of such extensions, copies of which are hereto annexed, marked B and C, the originals of which will be produced whenever the court shall require.

And your orators further state that the said Charles Watt and Hugh Burgess, by an instrument in writing duly executed on the twentieth day of April, A. D. 1867, a copy of which is hereto annexed, marked D, duly executed and delivered to your orators and recorded in the Patent Office, Liber R 9, p. 145, of the transfers of patents, conveyed to your orators all their right, title, and interest in said reissued patents for and during the extended terms thereof; whereby your orators became, and they now are the owners of said re-issued letters patent, and the inventions therein described, for the full period for which such extensions were granted.

And your orators further state that in the instrument conveying the said reissued letters patent to the said Charles Watt and Hugh Burgess, they reserved to themselves "all claims for damages and profits which have accrued to them, to have and recover from
560 and against all persons infringing upon said letters patent in the United States, and all claims for bonuses, tariffs, or royalties which have or may come to them from any licensees or other persons using the invention described in the specifications of said reissued letters patent during the term for which the same are granted, and reserving the control over any and all suits in law or in equity which have been, or which may be brought in the name of said company for the recovery of any such damages, profits, bonuses, tariffs, or royalties;" and that thereby, and by the said instrument of conveyance to them executed and recorded as last above stated, they became and were entitled continuously to all the damages and profits which they might have been entitled to recover on said original bill of complaint to the day of the expiration of the original term of said letters patent, and also to the claims for damages and profits accruing to them by reason of the infringements alleged in said original bill of complaint, and in the manner therein alleged, for and during the term for which said reissued patents have been extended, and to the relief as prayed for in said original bill by injunction against the continuance of said infringements by the defendants during said ex-extended term.

And your orators aver, upon information and belief, that said defendants, since the nineteenth day of August, A. D. 1867, well knowing the premises and the rights and privileges secured to your orators by the said letters patent so reissued, extended, and conveyed to them as aforesaid, and contriving to injure your orators and to de-

fraud them of their profits, benefits, and advantages which might and otherwise would have accrued to them, at Philadelphia aforesaid, and within the eastern district of Pennsylvania, and without the li-
561 cense and permission of your orators, since the nineteenth day of August, A. D. 1867, have unlawfully and wrongfully manufactured and sold large quantities of paper and paper pulp, manufactured in accordance with the descriptions set forth and by means of the processes described in the specifications annexed to said letters patent, as set forth in said original bill of complaint, and have manufactured and sold or used, or vended to others to be used, large quantities of the new manufacture called paper pulp, manufactured by chemical process, as described in the specifications of the said reissue No. 1,448 of the Watt and Burgess patent, and are now unlawfully and wrongfully manufacturing and using, or vending to others to be used, large quantities of paper and paper pulp, manufactured in accordance with the descriptions set forth and by means of the process and machinery described in the specifications annexed to said letters patent, or some one or more of them, and are now manufacturing and selling or using, and vending to others to be used, large quantities of the new manufacture called paper pulp, manufactured by chemical process as described in the specification of the said reissue No. 1,449 of the Watt and Burgess patent, and that said paper and paper pulp so manufactured and sold or used by said defendant, is manufactured by the use of the processes described in the patents, copies of which are annexed to said original bill of complaint, used in combination with each other, or in a combination of some two or more of them. But what quantity of paper and paper pulp manufactured according to said process, has been manufactured or sold, or caused to be sold by said defendant, or what quantity of said new manufacture of paper pulp has been manufactured or used, or sold to others to be used, by said defendant , your orators do not know and cannot state; but, upon information and belief, your orators aver that said defendant ha sold to others to be used, and ha manufactured and used, large quantities of the same, and
562 that they have derived and received, and still are deriving and receiving from such sale, great gains and profits, but to what amount your orators are ignorant and cannot set forth; but your orators believe the same to be of the full sum of ten thousand dollars, and so charge the fact to be, and pray that the defendants may be required to make a disclosure of all such gains and profits.

And your orators in like manner aver, that the defendants continue to manufacture and sell said paper and paper pulp, and said new manufacture of paper pulp, and the use thereof as aforesaid, though warned and requested to desist from said manufacture, sale, and use, or to pay to your orators the said gains and profits, by means whereof the defendant have greatly injured, and are still greatly injuring your orators, and have deprived, and are still depriving, your orators from receiving the gains and profits from the exclusive right to use the inventions and improvements claimed in the said reissued and extended letters patent, which your orators otherwise, and but for

such wrongful acts of the defendants, would have obtained and received.

And your orators pray that the said defendants may be compelled, by a decree of this court, to account for and to pay over to your orators all such gains and profits as have accrued or arisen to, or been earned or received by said defendants, and all such gains and profits as have been received, or to which they may be entitled by reason of such sale by them of paper pulp, manufactured from wood and other vegetable substances, and of paper manufactured from wood, in accordance with the specifications of the above-named letters patent, and in infringement thereof, and all such gains and profits as your orators would have received but for the unlawful acts and do-
563 ings of the said defendants; and that the said defendants, their attorneys, solicitors, servants, agents, and workmen, may be perpetually enjoined and restrained, by the decree and injunction of this court, from directly or indirectly making or causing to be made, or using or causing to be used, or vending to others to be used, in any manner, any paper pulp manufactured from wood or other vegetable substances, or any paper manufactured from wood substantially, as described in the above-named reissued and extended patents, and from using any of the inventions or improvements described and claimed in said reissued and extended patents in the manufacture of paper pulp from wood or other vegetable substances, and in the manufacture of paper from wood, and from infringing upon or violating the said reissued and extended letters patent, in respect of the exclusive rights vested in your orators, and that all such infringing paper or paper pulp may be forthwith destroyed or delivered up to your orators.

And also, that the testimony taken by your orators upon the issues raised by the pleadings upon said Watt and Burgess' patent, may be made a part of the evidence in the hearing of the issues upon this supplemental bill, as if the same had been taken after issue joined hereon, and that the defendant may be decreed to pay the costs of this suit; and that your orators may have such other relief as the equity of the case may require, and as to your honors may seem meet.

To the end, therefore, that the said defendants may, if they can, show why your orators should not have the relief hereby prayed, and may full, true, and direct answer make, according to the best of their knowledge, remembrance, information, and belief, to the several matters hereinbefore averred and set forth, may it please your honors to give unto your orators a writ of subpœna ad respondendum,
564 issuing out of and under the seal of this honorable court, directed to the said defendants, Jacob D. Heft, S. A. Rudolph, and John W. Dixon, commanding them to appear and make answer to this bill of complaint, and to perform and abide by such order and decree herein as to this court may seem required by the principles of equity and good conscience.

May it also please your honors to grant unto your orators a provisional or preliminary injunction, issuing out of and under the seal of this

honorable court, enjoining and restraining the defendants, their attorneys, solicitors, servants, workmen, and agents, to the same purport, tenor, and effect hereinbefore prayed for in regard to said perpetual injunction. And your orators will ever pray.

H. C. WALLACE,
Solicitor for Complainants.
T. A. JENCKES, *of Counsel.*

565 UNITED STATES OF AMERICA, *District of* ———, *ss:*

I, , treasurer of the said American Wood Paper Company, do solemnly , that the facts and statements in said supplemental bill contained, which are made upon knowledge, are true, to the knowledge of this affiant, and that those which are made upon information and belief are true, according to the best of his information and belief, and according to the best of the information and belief of said complainants.

Subscribed and sworn to, at , this day of , A. D. 186 , before me.

566 *Exhibit "A."*

To all persons to whom these presents shall come:

Whereas letters patent of the United states, bearing date the eighteenth day of July, Anno Domini 1854, ante-dated to August 19th, Anno Domino 1853, were issued to Charles Watt and Hugh Burgess, of London, England, for the invention of a new and usefnl improvement in the manufacture of paper from wood, which letters patent, by sundry mesne assignments, became the property of William F. Ladd and Morris L. Keen, who surrendered the same and obtained a reissue thereof to them as assignees of the entire interest in said letters patent, on an amended specification, bearing date the fifth day of October, Anno Domini 1858, and who also again surrendered the same and obtained a re-issue thereof upon amended specifications in two letters patent being re-issued patents No. 1,448 and No. 1.449; and whereas the said Charles Watt and Hugh Burgess are desirous of acquiring the title thereto, which said title has become vested in the American Wood Paper Company, a corporation created by the general assembly of the State of Rhode Island, and located and transacting business in Providence, in said State:

Now, therefore, this indenture witnesseth, that for and in consideration of the sum of one dollar, and other valuable considerations paid to said American Wood Paper Company, the receipt of which is hereby acknowledged, the said company have assigned, sold and set over, do hereby assign, sell and set over unto the said Charles Watt and Hugh Burgess, all the right, title and interest which said company have in the said invention, as secured to them by said re-
issued patents, numbered 1,448 and 1,449, for, to, and in the
567 United States of America, and the Territories thereof; the same to be held and enjoyed by the said Charles Watt and

Hugh Burgess, for their own use and behoof, and for the use and behoof of their legal representatives, to the full end of the term for which said letters patent are granted, reserving to said company, however, all claims for damages and profits which have accrued to them to have and recover from and against all persons infringing upon said letters patent in the United States, and all claims for bonuses, tariffs, or royalties, which have or may come to them from any licensees or other persons using the invention described in the specifications of said re-issued letters patent, during the term for which the same are granted, and reserving the control over any and all suits in law or in equity, which have been or which may be brought in the name of said company for the recovery of any such damages, profits, bonuses, tariffs or royalties.

In testimony whereof, the said American Wood Paper Company, by William S. Slater, their treasurer, duly authorized for that purpose, have hereunto caused their name and corporate seal to he affixed, this seventeenth day of April, Anno Domini, one thousand eight hundred and sixty-seven (1867.)

AMERICAN WOOD PAPER COMPANY·
WM. S. SLATER, *Treasurer.*

Executed and delivered in the presence of—
WM. F. LADD.
WM. F. LADD, JR.
U. S. Patent Office.

(U. S. rev. stamp, 5 cents. Cancelled.)

Received for record July 19, 1867, and recorded in Liber P, page 215, of Transfers of Patents.

In testimony whereof, I have caused the seal of the Patent Office to be hereunto affixed.

T. C. THEAKER,
Com'r. of Patents.

[Seal of Patent Office.]

568 *Exhibit "B."*

Whereas, upon the petition of Charles Watt and Hugh Burgess, of London, England, for the extension of the patent granted to them July eighteenth, 1854, ante-dated August nineteenth, 1853; reissued October, fifth, 1858, and again reissued April seventh, 1863, in two divisions, viz: No. 1,448 for "Improved pulp from wood, &c., for the manufacture of paper;" and No. 1,449 for "Improved process of treating wood or other vegetable substances in the manufacture of paper pulp," the undersigned, in accordance with the eighteenth section of the act of Congress, approved the fourth day of July, 1836, entitled "An act to promote the progress of the useful arts, and to repeal all acts and parts of acts heretofore made for that purpose;" and the act approved the twenty-seventh day of May, 1848, entitled "An act to provide additional examiners in the Patent Office, and

for other purposes," did, on this seventeenth day of August, 1867, decide that said division No. 1,448 of said patent ought to be extended.

Now, therefore, I, Thomas C. Theaker, Commissioner of Patents, by virtue of the power vested in me by said acts of Congress, do renew and extend said division of said patent, and certify that the same is hereby extended, for the term of seven years from and after the expiration of the first term, viz: from the nineteenth day August, 1867; which certificate, being duly entered of record in the Patent Office, division of said patent has now the effect in law as though the same had been originally granted for the term of twenty-one years.

In testimony whereof, I have caused the seal of the Patent Office to be hereunto affixed this seventeenth day of August, 1867, and of the independence of the United States the ninety-second.

T. C. THEAKER,

[SEAL OF PATENT OFFICE.] *Commissioner.*

569 *Exhibit "C."*

Whereas, upon the petition of Charles Watt and Hugh Burgess, of London, England, for the extension of the patent granted to them July eighteenth, 1854, ante-dated August nineteenth, 1853, reissued October fifth, 1858, and again reissued April seventh, 1863, in two divisions, viz: No. 1,448, for "Improved pulp from wood, &c., for the manufacture of paper," and No. 1,449, for "Improved process of treating wood or other vegetable substances in the manufacture of paper pulp," the undersigned, in accordance with the eighteenth section of the act of Congress, approved the fourth day of July, 1836, entitled "An act to promote the progress of the useful arts, and to repeal all acts and parts of acts heretofore made for that purpose;" and the act approved twenty-seventh day of May, 1848, entitled "An act to provide additional examiners in the Patent Office, and for other purposes," did, on this seventeenth day of August, 1867, decide that said division No. 1,449 of said patent ought to be extended.

Now, therefore, I, Thomas C. Theaker, Commissioner of Patents, by virtue of the power vested in me by said acts of Congress, do renew and extend said division No. 1,449 of said patent, and certify that the same is hereby extended for the term of seven years from and after the expiration of the first term, viz: from the nineteenth day August, 1867, which certificate, being duly entered of record in the Patent Office, the said division No. 1,449 of said patent has now the same effect in law as though the same had been originally granted for the term of twenty-one years.

In testimony whereof, I have caused the seal of the Patent Office to be hereunto affixed this seventeenth day of August, 1867, and of the independence of the United States the ninety-second.

T. C. THEAKER,

[SEAL OF PATENT OFFICE.] *Commissioner*

570 *Exhibit "D."*

To all to whom these presents shall come:

Whereas, letters patent of the United States, bearing date the eighteenth day of July, in the year of our Lord one thousand eight hundred and fifty-four, were issued to Charles Watt and Hugh Burgess, of London, England, for fourteen years from the nineteenth day of August, in the year of our Lord one thousand eight hundred and fifty-three, for the invention of a new and useful improvement in the manufacture of paper from wood, which letters patent were subsequently surrendered by William F. Ladd and Morris L. Keen, assignees thereof, and a reissue thereof granted on the fifth day of October, in the year of our Lord one thousand eight hundred and fifty-eight, and again surrendered, and again reissued to said Ladd and Keen on the 7th day of April, in the year of our Lord, one thousand eight hundred and sixty.three, in two separate patents, one, reissue No. 1,448, for a new and useful improvement in the manufacture of paper pulp from wood and other vegetable substances, and the other reissue No. 1,449, for certain improvements in pulping and disintegrating wood and other vegetable substances, which said reissued letters patent have through mesne assignments been transferred to the said Charles Watt and Hugh Burgess. And,

Whereas, the American Wood Paper Company, a corporation created by the legislature of the State of Rhode Island, and located and transacting business in the city of Providence, in said State, are desirous of purchasing the title to said invention, for the original and for any extended term of said letters patent.

Now this indenture witnesseth, that for and in consideration of one dollar, and other valuable considerations to us in hand paid
571 by said company, the receipt of which is hereby acknowledged, we have assigned, sold, and set over, and by these presents do assign, sell, and set over unto the said American Wood Paper Company, their successors and assigns, all the right, title and interest which we have in the said invention as secured to us by said original letters patent, and by the reissues thereof, as aforesaid, for, to, and in the United States of America and the Territories thereof, to be held and enjoyed by the said American Wood Paper Company, their successors and assigns, for their own use and behoof, to the full end of the term for which said letters patent were originally granted, and to the full end of the term for which they may be extended under the acts of Congress.

And we do also hereby assign and convey to said American Wood Paper Company, their successors and assigns, all our claims for damages and profits against any and all persons using our said invention, and do hereby constitue said company our attorney irrevocable with full power of substitution, in our name, and at their expense, and for their use, to sue for and recover all such claims for damages and profits from any and all infringers of said letters patent.

In testimony whereof, we have hereunto set our hands and affixed

our seals this twentieth day of April, in the year of our Lord one thousand eight hundred and sixty-seven.

Sealed and delivered in presence of us—

[SEAL.] CHARLES WATT,
[SEAL.] HUGH BURGESS.

[U. S. stamp, $1 20, cancelled.]

572 *ss*:

Personally appeared before me, William Nichols, of No. 26 Abchurch lane, in the city of London, notary public, William Robert Brooks and Ephraim Edward McDowall, whose names are subscribed to the foregoing instrument as witnesses to the execution thereof, and severally declared that their signatures thereto are their genuine signatures, and that the signatures of the said Charles Watt and Hugh Burgess thereto are also genuine, and that they saw them respectively write the same in their presence, and that they acknowledge the same to be their free act and deed.

WILLIAM NICHOLS, *Notary Public.*

573 CONSULATE OF THE UNITED STATES OF AMERICA, AT LONDON.

I, Joshua Nunn, deputy consul of the United States of America for London and the dependencies thereof, do hereby make known and certify to all whom it may concern, that William Nichols, before whom the annexed affidavits of William R. Brooks and Ephraim E. McDowall were made, as appears by his signature thereto, is a notary public, duly admitted and sworn, practising in the city of London aforesaid, and authorized to receive affidavits, and that to all acts by him so done full faith and credit are and ought to be given in judicature and thereout.

In testimony whereof, I have hereunto set my hand and affixed the seal of the consulate of the United States at London aforesaid, this twentieth day of April, in the year of our Lord one thousand eight hundred and sixty-seven, and in the ninety-first year of the independence of the said United States.

JOSHUA NUNN.

UNITED STATES PATENT OFFICE.

Received for record August 19, 1867, and recorded in Liber R. q, page 145, of Transfers of Patents.

In testimony whereof I have caused the seal of the Patent Office to be hereunto affixed.

[L. S.] A. M. STOUT,
Acting Commissioner of Patents.

574 Circuit Court of the United States, eastern district of Penna.

Amendments to the defendant's answer.

AMERICAN WOOD PAPER CO.,
vs.
D. HEFT *et al.*

Said amendments 12 and 13 are to be inserted after the eleventh proposition under the head of answers § II, after the 6th proposition under the head of answers.

12. That the specifications of said reissued letters patent, No. 1,448 and No. 1,449, of April, 1863, do not fully and clearly set forth the alleged invention so as to enable a person skilled in the art to practise the same, and by reason thereof said complainant is not entitled to maintain his suit on said patent.

13. That the specifications of said reissued letters patent, No. 1,448 and 1,449, of April, 1863, do not fully and clearly set forth the alledged invention so as to enable a person skilled in the art to practise the same. The specification contains concealments and additions made with a view to deceive the public, and that by reason thereof the said letters patent are void.

6. The said alleged invention of C. A. Mellier, patented May 26, 1857, was in public use and sale in the United States prior to the application for a patent thereof and that by reason thereof said letters patent are void.

GEO. HARDING,
Attorney for Defendant.

Amendment allowed.

H. E. WALLACE,
Attorney for Plaintiff

September 24, 1866.

575 In the Circuit Court of the United States for the eastern district of Pennsylvania.

The joint and several answers of Jacob D. Heft et al., defendants, to the supplemental bill of said complainant filed in the case.

THE AMERICAN WOOD PAPER COMPANY
vs.
JACOB D. HEFT *et al.*
No. 21. April session, 1865.

These defendants, now and at all times hereafter, saving and reserving to themselves and each of them, all and all manner of benefit and advantage of exception that can or may be had or taken to the many errors, insufficiencies, and imperfections in the said bill of complaint contained for answer thereto, or unto so much thereof as they are advised it is material and necessary for them to make answer unto, answering, say:

That they are informed and believe that it is true, as the same is alleged in the said supplemental bill of complaint of the said com .

plainant, that said complainants, by an instrument of writing, did convey unto said Charles Watt and Hugh Burgess all the right, title, and interest of them, the said complainants, in said reissued letters patent, and that said Charles Watt and Hugh Burgess thereupon applied to the Commissioner of Patents for the extension of the said patents for the further term of seven years from the 19th day of August, A. D. 1867, which, after the proceedings required by law were duly had thereon, were duly granted in manner and form as stated in said bill of complaint.

And said defendants, further answering on information and belief, say that the said Charles Watt and Hugh Burgess, by an
576 instrument of writing dated the 20th day of April, A. D. 1857, recorded in the Patent Office, Liber R. 9, p. 145, of Transfers of Patents, conveyed to said complainant all their right, title and interest in said reissued patents for and during the extended term thereof, whereby said complainants became the owners of said reissued letters patent, and the inventions therein described, for the full period for which such extensions were granted.

And said defendants, further answering said supplemental bill of the said complainant, renew, aver and maintain all the allegations, averments, demurrers, pleas and answers therein set forth in answer to the said original bill of the said complainant, and the amendments thereto, and claim the full benefit and advantage thereof against the said supplemental bill of said complaint, as though the same were herein fully and at large set forth.

GEO. HARDING,
Sol. for Defts.

It is agreed the above answer be filed without affidavit.

H. E. WALLACE,
Sol. for Comp.

577 In the Circuit Court of the United States for the eastern district of Pennsylvania, sitting in equity. April term, 1865, No. 20.

The replication of the American Wood Paper Co., complainant, to the answer of Jacob D. Heft, S. A. Rudolph, and John W. Dixon, defendants.

THE AMERICAN WOOD PAPER CO., plaintiff,
vs.
JACOB D. HEFT, *et al.*, defendants.

The said repliant saving and reserving all manner of exception to the manifold insufficiencies of the said answer, for replication thereunto, saith: That they will aver and prove their said bill to be true, certain, and sufficient in the law to be answered unto, and that the said answer of the defendants is uncertain, untrue, and insufficient to be replied unto by this repliant, without this, that any other matter or thing whatsoever in the said answer contained, material or

effectual in the law to be replied unto, confessed and avoided, traversed or denied, is true; all which matters and things the said repliants are and will be ready to aver and prove, as this honorable court shall direct, and humbly pray as in and by their said bill they have already prayed.

HENRY E. WALLACE,
Solicitor for Complainant.

578 In the Circuit Court of the United States for the eastern district of Pennsylvania.

Opinion.

THE AMERICAN WOOD PAPER COMPANY
vs.
HEFT & Co.
} In equity.

By GRIER, J.

1. That the reissued patents of 1863 are illegal and void, requires no further reasons than those alleged in the answer and clearly substantiated by the evidence.

Mellier's patent is intended for straw alone, et similia.

He was not the first to succeed in this enterprise.

His patent must be construed by taking a view of all its parts.

He says his invention consists in subjecting straw to a pressure of at least seventy pounds to the square inch—prefers eighty.

"I have found by experiment that it is essential that a temperature equivalent to seventy pounds must be employed."

The only practical method of determining the temperature of the liquid is by noting the pressure on the boiler—testimony of Burgess.

579 Accordingly the patentee describes seventy pounds as synonomous with 310° Fahrenheit. Again he describes it at seventy to eighty-four pounds. The claim uses the term not less than 310° Fahrenheit, which he has before defined by seventy pounds to the square inch.

The claim of this patent was sustained only against those who went beyond the seventy pounds in New York.

The process used by defendants does not come up to the minimum claimed by Mellier.

The plaintiffs do not use over sixty pounds to the square inch.

There is no proof that defendants infringe either of Keen's boiler patents, that of 1859 or 1863.

Keen's patent of 1859 is for a combination of devices which is not used by defendants,

His patent of 1863 claims a perforated diaphragm of which he was not the inventor. See Martin Nixon's patent, 1853.

Nor was he first to use a discharge pipe and valve for the purpose of blowing out or discharging the contents of the boiler under pressure.

The arrangement of a discharge pipe, with stop cock, is what

every one using a vertical boiler might use without invention, and is not open to be monopolized by Keen.

The combination of devices in defendant's, Dixon's, patent has more claim to originality and invention, and does not infringe either of Keen's patents.

The bill ought to be dismissed.

580 In the Circuit Court of the United States for the eastern district of Pennsylvania.

THE AMERICAN WOOD PAPER COMPANY *vs.* HEFT AND COMPANY. } In Equity.

CADWALLADER, J.

As to the patents for alleged improvements in the boiler or its appendages. it may suffice to say, that so far as the alleged inventions may have been patentable and new they have not been infringed.

The other patents on which the bill is founded require careful consideration. I regret that the early departure of the circuit judge for Washington renders a decision so soon after the argument necessary.

Watt and Burgess, practical chemists, on 19th August, 1863, obtained a patent in England. On 18th July, 1854, they obtained one from the United States, for the same alleged invention, for fourteen years from the date of their English patent. The patent from the United States and a reissued patent, which was substituted for it, have been successively surrendered, and a second reissue has been obtained. This reissue was in two patents, dated 7th April, 1863, Nos. 1,448 and 1,449. Each describes a process for boiling fine shavings or cuttings of wood, or other vegetable substances, in a solution of caustic alkali, in a close vessel, under a high pressure, in order to obtain a pulp fit for making paper, the length of the time of boiling, and the strength and heat of the solution graduated respectively to one another, and to the more or less refractory nature of the vegetable substance to be thus treated; the duration of such boiling from four hours to twelve; the strength of the solution from 17° to 12° or 10° T., corresponding with 12° to $8\frac{1}{2}$° or $7\frac{1}{4}$° B.; and the heat ordinarily "at, near, or above" 300° F., which might, however, be raised to 500°. This means a minimum heat, not much below that indicated on the steam gauge as due to a pressure of fifty
581 pounds to the square inch, which heat might be increased as required. The pressure appears, from the evidence, to be no further useful than as the required heat of the liquid above 212° cannot be imparted except under pressure, nor measured otherwise than by the degree of pressure as indicated on a steam gauge. The specification implies that the graduation of the heat, the strength, and the duration were to depend, in a great measure, upon experience, not restricted within narrow limits. Their graduation to

the nature of the vegetable substance, whatever it might be, is expressly required in the specification. Their adjustment or graduation to one another, as occasion might require, though not expressed, is obviously implied.

The claim in the specification of No. 1,448 is of the invention of a pulp suitable for the manufacture of paper made from wood or other vegetable substances by boiling in an alkali under pressure, substantially as described. The claim in the specification of No. 1,449 is the invention of treating wood or other vegetable substances, by boiling in an alkali, under pressure, as a process, or preparatory process, formaking pulp for the manufacture of paper substantially as described.

The invention claimed in these two patents, whether that of a product or that of a process, depends wholly upon boiling in an alkaline solution in a close vessel with such graduation of heat, strength, and time to one another and to the refractoriness of the material as may produce a suitable pulp at one operation.

The question is whether Watt and Burgess invented either the product or the process at or before the date of their English patent of 19th August, 1853, to which the American patents relate.

Before this date and before any maturity of their previous experiments, a pulp fit for making paper had been obtained by others from such fibrous substances as wood and straw, through the use of different processes for disintegration of the fibres. In every such case the process had been one of successive stages. The substances had been boiled in an alkali, strong or weak, in open vessels and in close ones, under pressure and without pressure. The process had never
582 been such as to produce the pulp at one operation. In some cases the boiling itself had been repeated. In all of them there had, besides mere soaking and cleansing, been a succession of mechanical or of chemical treatments, or of both, with applications of heat. But, as I have already stated, a suitable pulp, that is to say, cellulose, approximately pure, had, through some of these former processes, been obtained from both wood and straw. It is thus very clear that Watt & Burgess did not, nor did either of them, invent or discover the product as distinguished from the process.

As to the process, it was, on the part of the defendants, assumed that the case must be decided upon the patent No. 1,449 alone, and, independently of the question whether the process in itself was new, the argument was urged that this patent was invalid because it claimed too much. The claim in it is for the invention of a process, or preparatory process. The novelty, if there was any, consisting wholly in the singleness of the process, it could not, according to the argument, be considered new as a preparatory process. Perhaps the phrase preparatory process, in the specification of this patent, has not precisely the meaning which this argument attributes to it. Pulp which is already fit for making brown paper, requires bleaching in order to render it suitable for making white paper. If no farther treatment than suffices to whiten the pulp is required for the latter purpose, the same process which suffices to finish the pulp for mak-

ing brown paper, is thus, in a relative sense, preparatory as to white paper. If this were otherwise, the objection to the patent could be removed by a disclaimer, as was done in Morse's case, 15 Howard, 120, 121. It is therefore unnecessary to inquire whether the difficulty might not also be avoided by recurring to the patent No. 1,448, which is not simply for a product, but for the product as made by the single process described.

The specification will therefore be considered as including a legally-sufficient claim of the invention of the process of boiling in an alkaline solution in a close vessel with such a graduation and adjustment of heat, strength and time, as will produce the pulp at a single operation. That the process thus claimed, if actually invented by Watt & Burgess at any time not later than the date of their
583 English patent, was new, is, I think, on the evidence, unquestionable. Therefore if they had invented it by the 19th of August, 1853, the reissued patent must be sustained.

The evidence upon the question of fact as to the alleged invention of this date consists of the testimony of Mr. Burgess, and his manuscripts which have been preserved, the specifications of the English patent, and of the first patent obtained from the United States; the correspondence and other papers on file in the Patent Office, and the specimens deposited there. Let us consider first the documentary evidence, and afterwards the testimony of Mr. Burgess.

It is quite clear from all the writings which are not of date subsequent to the American patent of July, 1854, that what was patented and what it was intended to patent in 1853 and 1854 was an alleged invention of a process of successive stages, one of which was boiling in an alkali, and that such boiling might be under pressure, but that this was optional. The patentees did not intend to describe or to claim any process completed at one operation, to which boiling under pressure was indispensable. It may be said that there is, nevertheless, no absolute impossibility that they had invented such a process, and that the legal question under the reissue is not what they had intended to patent, but what they had, in fact, invented. This, in the abstract, is true. But its mere legal truth does not lessen the immense improbability that they had, in fact, invented or discovered the process.

Nor is this improbability diminished by the testimony of Mr. Burgess, that economical considerations may have influenced the patentees to suppress, at the time, a part of their supposed invention. His testimony, as given to this effect at this late day, does not go, by any means, to the extent assumed in the argument for the complainants. If the matured invention had been fully conceived by him, it is probable that motives of economy would, on the contrary, have suggested the idea of elevating the temperature in order to reduce the quantity of alkali used. The experiments of Watt and Burgess in England were begun in 1851, and there is nothing in the testimony of Mr. Burgess to induce a belief that by 19th of August, 1853, either of them had made any experiment with a view to such
584 a simultaneous graduation of the time of boiling, and gradua-

tion of the heat and of the strength of the solution, as was required for a process of only a single stage. He testifies that in a laboratory in 1852 he produced a pure pulp by boiling in a caustic alkaline solution. But how long it was boiled, he does not state, nor of what strength was the liquid. He says that he had not the means at his disposal for determining the pressure used. How many or what were the stages of the process he does mention. He left England for the United States in the early part of 1854. The single previous experiment in which he had made a pulp at one operation occupied only about twenty minutes, when he was alone in the laboratory. On this occasion he put about a pound of pine wood into a wrought iron mercury bottle of the size of about 14 by 6 or 8 inches. He could not recollect the strength of the solution, and had no means of determining the pressure. There was no ascertainment or estimate of strength, or heat, or time, much less graduation or adjustment of them, nor was there any attempt at either, unless it consisted in the simple use of extreme heat. From the shortness of the time, the pressure must, if the material was crude, have been very high, far above the extreme of tension for any working purpose. He does not appear to have had any mental conception of such a practical process as the patents of 1863 describe.

Great care in refering the different parts of his testimony to the proper periods must be observed, or it may be misapplied. In 1854, after the American patent of July in that year, he recommenced experiments in this country, and before the end of the same year had approximately matured them. Whether he then attained a sufficient knowledge of the process afterwards described in the reissued patents of 1863 cannot be material. If such was the fact, and if Mellier had not obtained his patent in the mean time, it would be the misfortune of the complainants that Mr. Burgess did not apply for an independent patent in the latter part of 1854, instead of referring his new invention, by the reissue, to the patent of August, 1853. But the misfortune could not be judicially remedied. No such invention had been made at that time, and consequently the bill, so far as it
585 rests upon the patents of re-issue, must be dismissed.

The remaining question is, whether the bill can be maintained on the patent to Mellier, which is also vested in the complainants. A patent granted to Ladet, in France, on 7th August, 1854, appears to have been obtained by him for this Mellier. The patent from the United States was obtained by Mellier himself on the 26th May, 1857, for fourteen years from the former date, 7th August, 1854. He had, in the meantime, in 1855, obtained a patent in England. The first claim, and many parts of the specification of his American patent are applicable to a subject which is here of no importance. Hereafter, when his claim is mentioned, it will be understood as the second claim. He describes the invention as a process for the treating of straw and other vegetable fibrous materials requiring like treatment preparatory to the use of such fibres in the manufacture of paper. The improvement, he says, consists in subjecting straw or such other fibrous materials to a pressure of at least

seventy pounds on the square inch, when boiling such fibrous matters in a solution of caustic alkali. For this purpose the straw, or fibrous matters, are cut, soaked and cleaned, and then placed in a suitable boiler. He prefers a temperture to produce at or above eighty pounds on the square inch in the boiler containing the fibrous materials; but says that so high a temperature is not absolutely necessary, for he has found by experiment a temperature equivalent to seventy pounds on the square inch essential. The quantity of alkali used is at the rate of about sixteen per cent. of the straw or fibrous substance under treatment. In describing the details of the process, he says that the heat is to be raised to such a degree as to attain and maintain for a time an internal pressure equal to, or exceeding seventy pounds on the square inch, that is about 310 degrees Fahrenheit, by which a considerable saving of alkali, as well as time and fuel, results, as compared with former means of using a caustic alkali in preparing straw and other fibres for paper makers. He adds, that by submitting the straw or similar fibrous materials to a pressure of between seventy and eighty-four pounds on the square inch inside of the boiler, he can reduce considerably the proportion of alkali, and that the solution which he preferred to use was to be from two to three degrees Baumé, and at the rate of about seventy gallons to each cwt. of straw or other fibrous vegetable matters requiring like treatment; and that he found it desirable to keep up the heat and pressure during about three hours after the above pressure obtained. After further washing, the straw or fibre may, he says, be bleached in the ordinary manner, and this will be found to be accomplished by a comparatively small quantity of chloride of lime.

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He declared that he did not claim the general use of caustic alkaline solutions, nor the employment generally of a close boiler for boiling straw or other vegetable fibrous substances, but claimed the process for bleaching straw consisting in boiling it in a solution of pure caustic soda from two to three degrees Beaumé, at a temperature not less than 310 degrees Fahrenheit, after it has been soaked and cleaned, and before submitting it to the action of a solution of chloride of lime from one to one and a half degrees substantially as described.

In this claim and in the body of the patent, the word bleaching is used with applications chemically the same, but practically somewhat different, through difference in degree. The word signifies, in the claim, a disintegrating, and in the body of the patent a mere whitening process.

The reason for giving so full an abstract, almost a transcript, of the material parts of the specification, with some of its repetitions of the same phrases, will appear as we proceed.

In the meantime, we may remark that wherever the number of pounds of pressure is mentioned by Mellier, he means the internal pressure, exceeding by 14 7–10 pounds, the pressure as indicated on the steam gauges here in use, the difference being the weight of the atmosphere. This difference must always be considered in comparing this French expression of the measure with the usual expression of it in this country. Thus the measure of 70 lbs. in the specifi-

cation of Mellier corresponds with about 55 lbs. on the steam gauge here in use. His French patent mentions a pressure of five or six atmospheres. From the less extreme, five atmospheres, the
587 deduction of one for this difference, leaves the minimum four atmospheres, not quite 59 lbs. An observation of less importance is that the tables used by him, according to which the degrees of heat are tested by the pressures, must have been somewhat inaccurate. Thus in the specification of his American patent, he gives 70 lbs., or, as indicated on our steam-gauges, about 55 lbs. as the pressure due to a heat of 310° Fahrenheit. The pressure due to such a heat should have been stated as internally about 74 lbs., or, as indicated on the steam-gauges, about 59 lbs. So in his English patent, he mentions 80 lbs. on the square inch as the pressure due to a heat of about 322° F., whereas the internal pressure due to such a heat is about 87 lbs., and the pressure, as indicated on our steam gauges, about 72 lbs. These comparisons are facilitated by the tables annexed to Dr. Rand's testimony.

It is argued for the defendant that the process described in this patent applies to straw alone, or is limited to it by the claim, that the patentee was not the first person who succeeded in applying the the process even to straw, and that, if he was, the claim is limited to the use of a temperature not below 310° F., which he defines as 70 lbs. to the square inch, internal pressure, (corresponding with a pressure of about 55 lbs., as indicated on the steam gauge,) that the pressure used by the defendants is below this, and that consequently they do not infringe the patent.

I do not think any part of this argument maintainable. As I understand the specification, it describes, in substance, the process afterwards claimed in the reissued patents of 1863, as the invention of Watt and Burgess. If so, Mellier would appear to have been the first person who discovered that the temperature and strength of the solution and the duration of the boiling could, in practice, be so graduated and adjusted as to produce the pulp at one operation.

The claim does not, in the apparent purpose of that part of it which mentions straw, resemble in all respects the claims ordinarily found at the foot of specifications of patents. If it did, it would limit the application of this patent to straw alone. But there is, in this respect, very little resemblance to such ordinary claims. The intended subjects of the process patented are explicitly and repeatedly
588 designated in the specification as straw and other fibrous vegetable substances requiring like treatment for the purpose in view. This treatment is exemplified with the requisite descriptive precision in the type case of straw. The description of this application of the treatment suffices to enable a skilful person to apply it to other substances requiring like treatment. Such a person ought to know, and if he did not, passages in the specification would instruct him, that with a crude fibrous vegetable substance, more refractory than straw, a stronger alkali, or a greater heat, or a longer time of boiling, would be necessary. In the application of the treatment to such a substance, the proportions which were as yet untaught by

science would be tested by future experience. The case of straw best exemplified the "considerable saving of alkali as well as time," &c., which the specification mentions. But a solution in which, at a certain temperature, straw could be made into a pulp in a certain time, would, if the strength were increased, and the time of boiling prolonged, serve to make wood into pulp, in the same close vessel, with, or perhaps without, an elevation of temperature. With an elevation of temperature the wood might be made into a pulp in the same time as the straw, or in a time somewhat longer, and, perhaps, in a solution of somewhat greater strength. Experience would furnish and test the standards.

The substances must, indeed, be such as require like treatment with straw for the purpose in view. But what is this purpose? It is to obtain cellulose approximately pure by disintegration. A fibrous vegetable substance, which is ligneous, is not the less an object of this purpose because it is ligneous, if the treatment of it should be similar, and differing only in graduation and adjustment.

That the treatment required for straw and for wood are not otherwise different appears, beyond a doubt, from the answers of the defendants in this case, and from the sworn report of the viewers who witnessed the processes at the defendant's manufactory. Their answer describes the process then and previously used by them in making pulp for paper from wood, and also in making it from straw. They at first treated wood with a solution of caustic alkali of the strength of 12° B.; but afterwards found a strength from 4° to
589 6°, say 5° to answer best. For straw they state that they have used a strength of about 3° B. For both wood and straw they state the pressure as between 50 lbs. and 60 lbs., not exceeding 60 lbs. In the subsequent experiments at the manufactory they used a pressure generally somewhat lower, but with a more than corresponding increase in the strength of the solutions.

The claim of Mellier sums up the specification so far as it had exemplified the application of the general process in the specific treatment of straw, which, when boiled in a solution of only 2° or 3° B., requires a temperature of at least 310° F., if this heat of the liquid is to be maintained, as he suggests, for only three hours. But in a solution of greater strength, like that used by the defendants for straw, with a cooking process continued for a longer time, as theirs was in the experiment witnessed by the viewers, the specification implies that a lower temperature would suffice. In Mellier's French patent the time of boiling mentioned is, instead of three, six or eight hours; and the strength of the solution, instead of 2° or 3° B., is 3° or 4° B. The French patent described the process as consisting in the production of a pulp, either white or of a color fit for the manufacture of paper from straw or other fibrous vegetable matters; and, in describing the details, occasionally mentioned straw without mentioning other materials.

Independently of recurrence to Mellier's French patent, I think his patent from the United States maintainable as to both wood and straw. I also think that the defendants have infringed as to each,

and that if the patent were limited to straw, there should be still a decree for the complainants. But I am of opinion that such an absolute restriction is within the fair import of the specification.

The difference of opinion upon the bench applies to this patent only. But it prevents a decree for the complainants. Their bill must be dismissed in order that they may be enabled to appeal. The dismissal should be without costs. If the decree had been in their favor, it should, I think, have been without costs.

590 Circuit Court of the United States, eastern district of Penna., April sessions, 1865.

THE AMERICAN WOOD PAPER CO.
vs.
HEFT *et al.*
} No. 20. In equity.

And now, to wit, on this 22d day of November, A. D. 1867, this cause came on to be heard at this term on bill, answer, and proofs. After consideration it is ordered, adjudged, and decreed that the bill be dismissed.

591 UNITED STATES OF AMERICA,
Eastern District of Pennsylania, sct:

I certify the foregoing to be a true and faithful copy of the record and proceedings of the Circuit Court of the United States in and for the eastern district of Pennsylvania, in the third circuit, in a suit in equity, lately depending therein between the American Wood Paper Company, complainants, and Jacob D. Heft, S. A. Rudolph, and John W. Dixon, defendants.

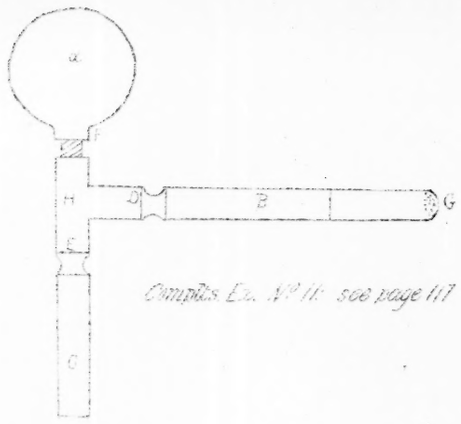
In testimony whereof, I have hereunto subscribed my name and affixed the seal of the said Circuit Court, at Philadelphia, this twenty-ninth day of November, A. D. 1867, and of the independence of the United States the ninety-second.

[SEAL.]

BENJ. PATTON,
Per W. GRIER HIBLER,
Clerk C. C. U. S.

[5-cent stamp.]

No 1

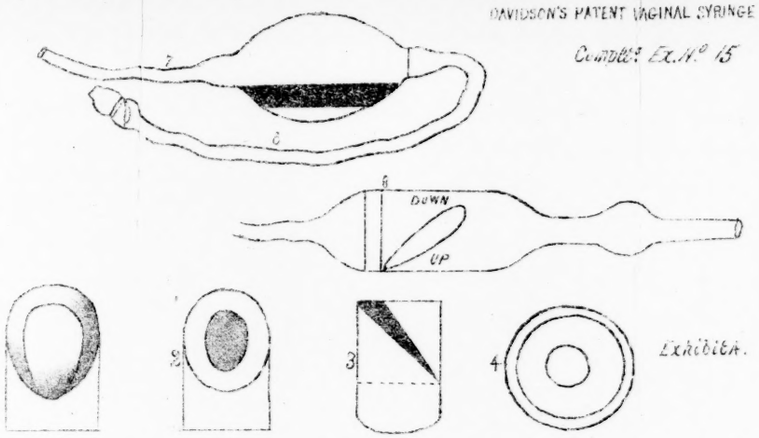


Complts Ex. N° 11 see page 117

No 2.

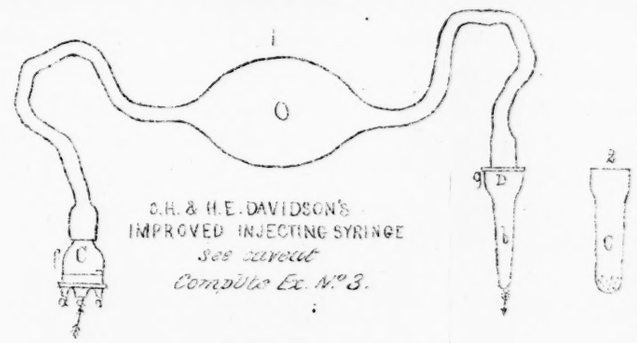
DAVIDSON'S PATENT VAGINAL SYRINGE

Complts Ex. N° 15



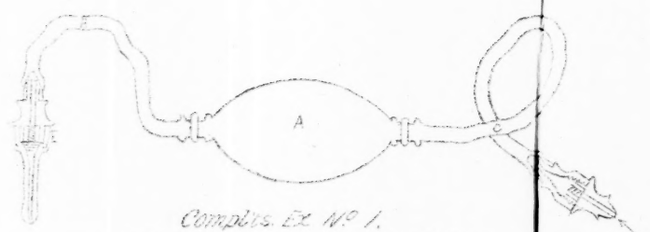
Exhibits.

No 3.



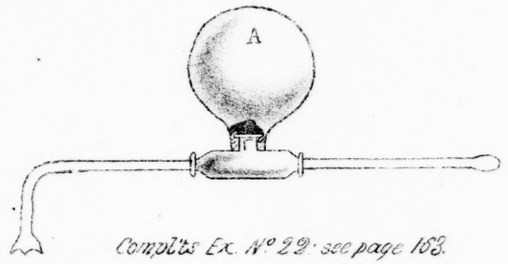
C.H. & H.E. DAVIDSON'S
IMPROVED INJECTING SYRINGE
See reverse
Complts Ex. N° 3.

No 4.



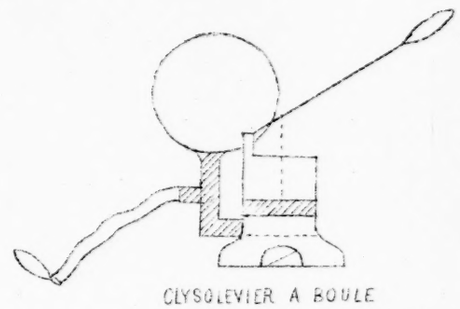
Complts Ex. N° 1.
SEE DAVIDSON'S ORIGINAL PATENT.

No 5.



Complts Ex. N° 22 · see page 163.

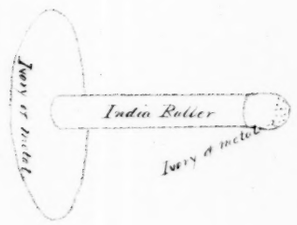
No 6



CLYSOLEVIER A BOULE
Complts Ex. N° 9. see page 171

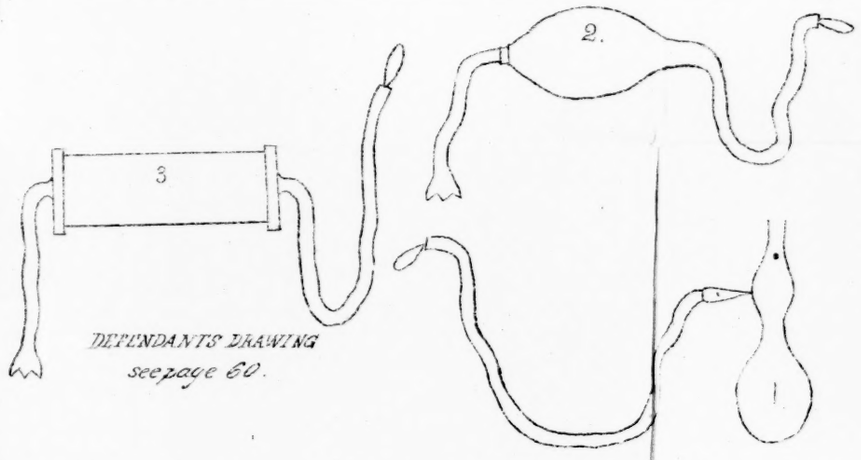
No 7.

CLYSODAME.



Complts Ex. N° 10 see page 172.

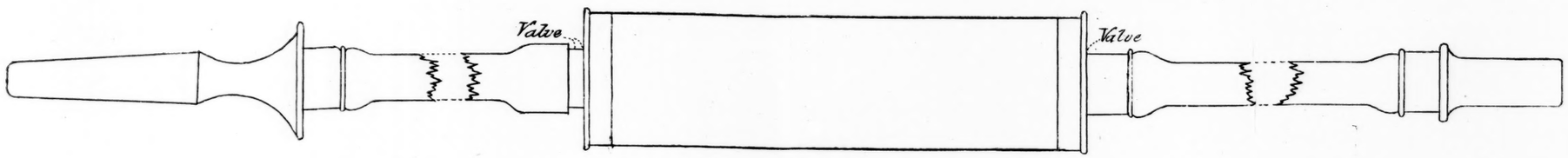
No 8



DEFENDANTS DRAWING
see page 60.

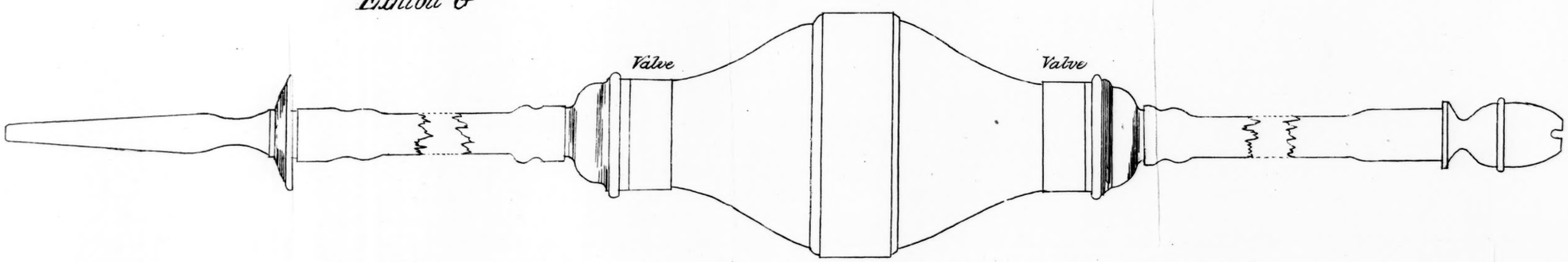
No 289 { Montgomerie / Lockwood

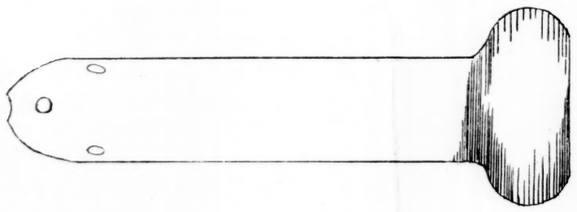
page 1

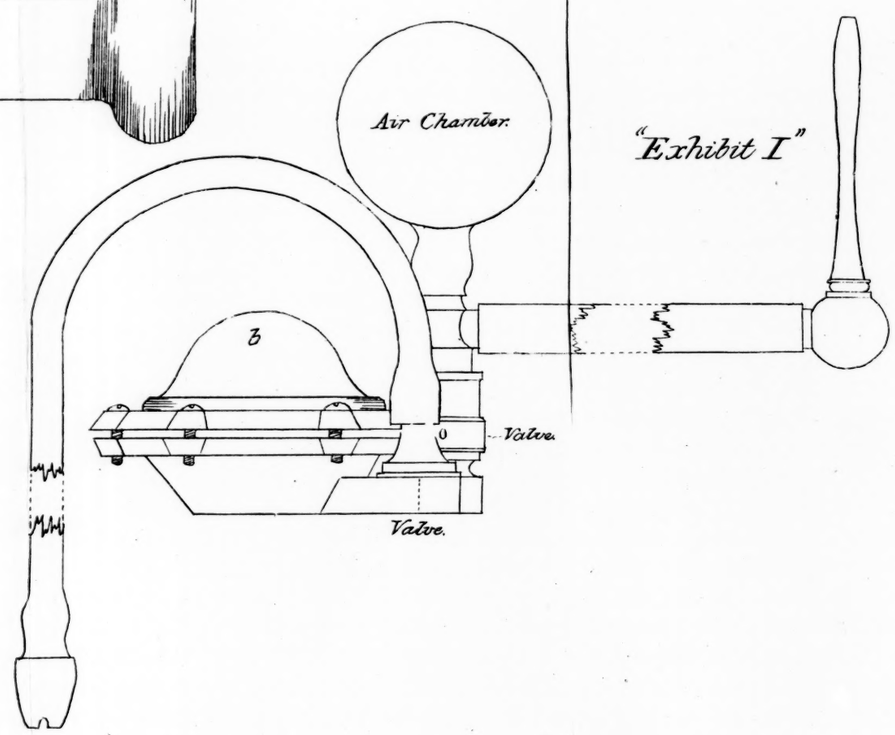


"Exhibit D"

"Exhibit G"







"Exhibit I"

No. 289 { Morey et al vi Lockwood page 1

No. 25,418.

Morris L. Keen's

Improved Boiler for boiling Paper Pulp under Pressure

Fig. 1.

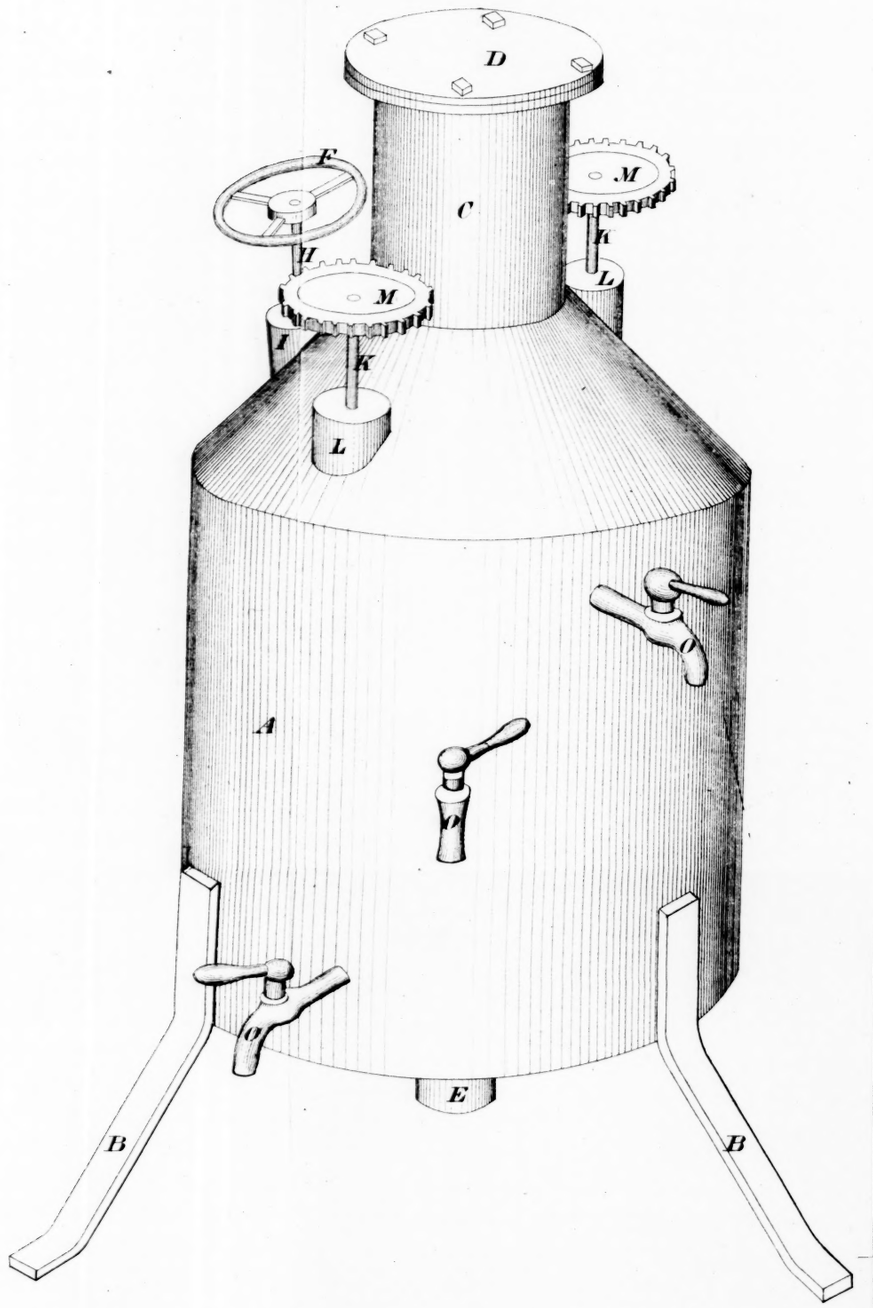
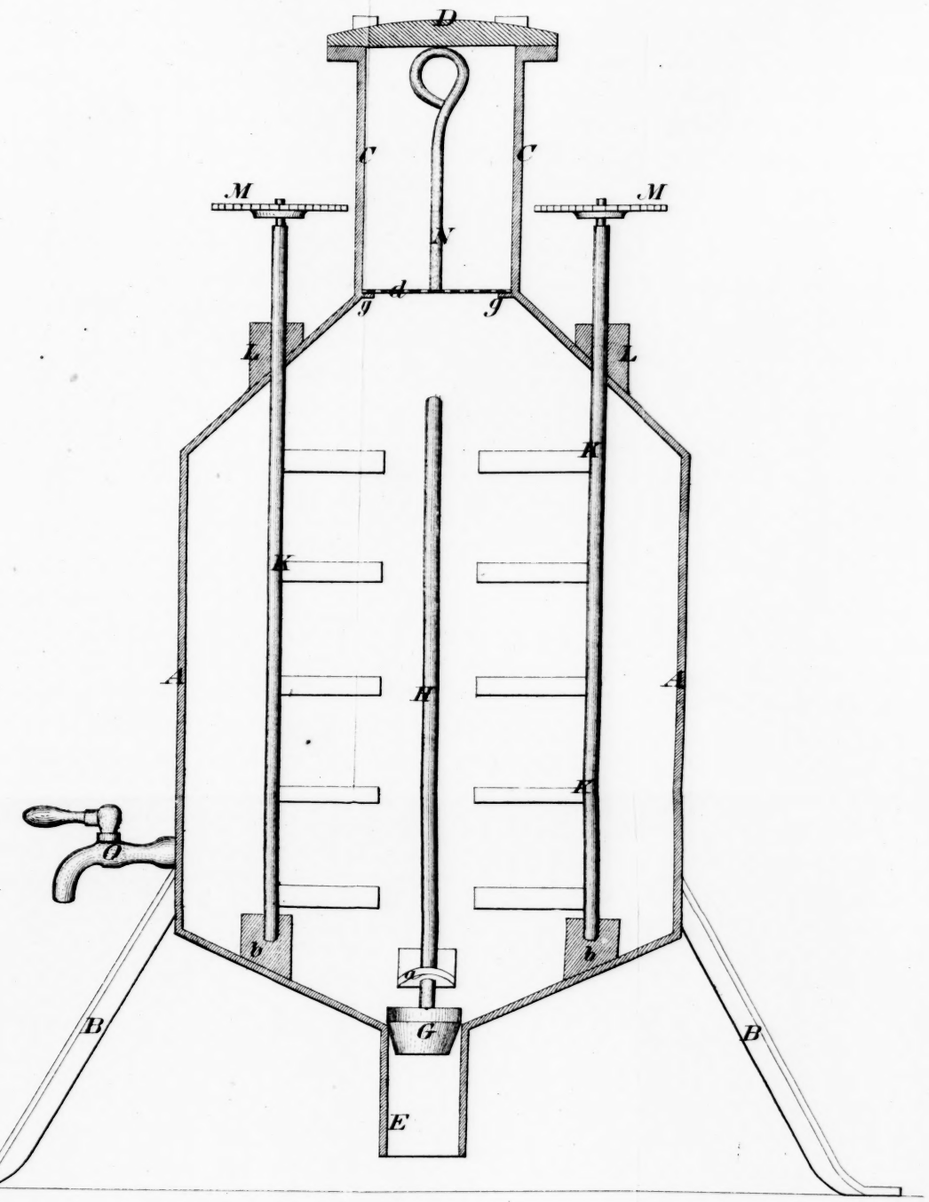


Fig. 2.



Correctly attached
Arthur L. Mc Intire. Drf. P. Off.

Witnesses:
Ephraim Miller.
Hugh Burgess.

Morris L. Keen.

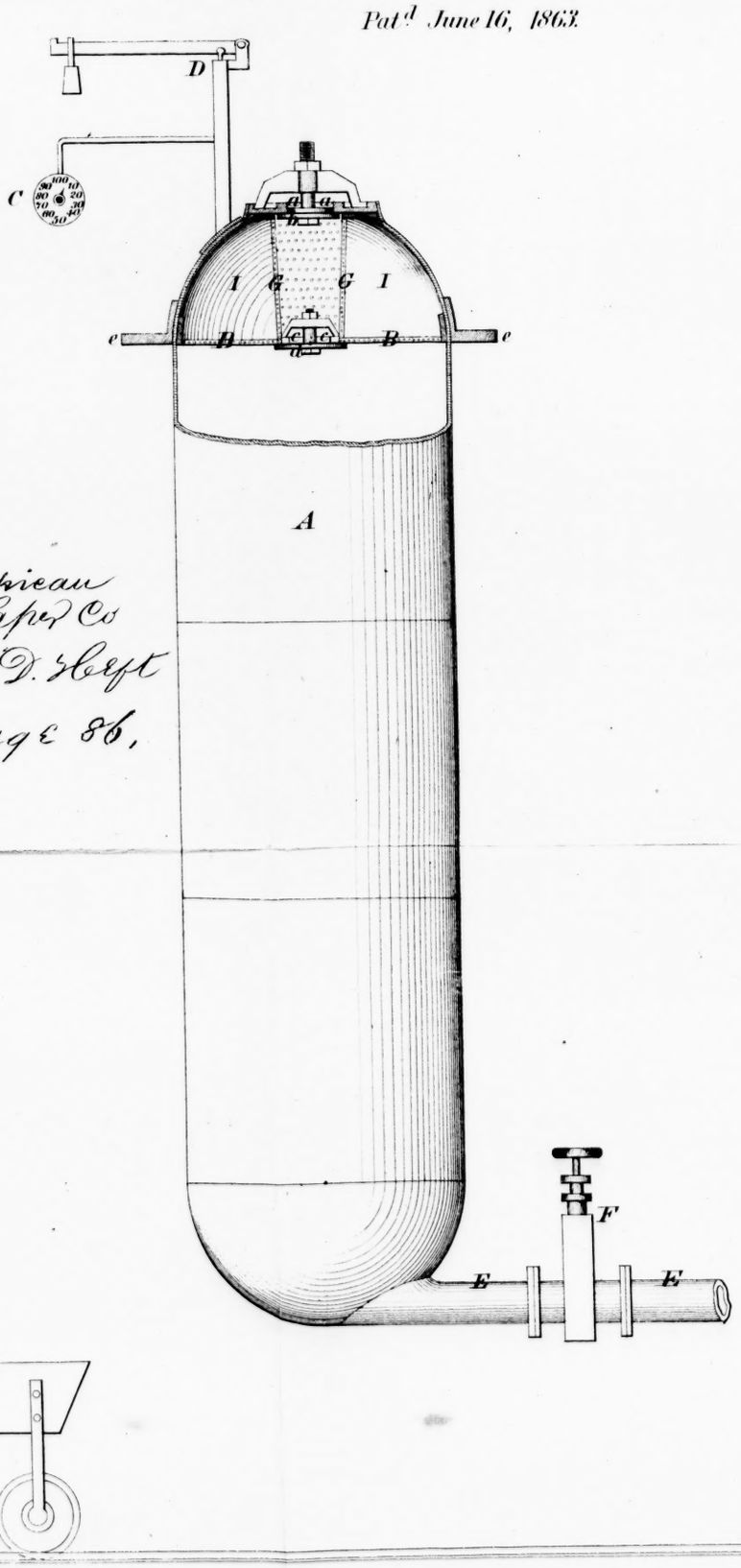
No 154 { The American Wood Paper Co page 81, vs. Jacob D. Heft.

No. 38,901.

Morris L. Keen's

Improvement in Boilers, for boiling paper pulp, and other material.

Pat.d June 16, 1863.



No. 154 { The American Wood Paper Co Jacob W. D. Heft

page 86,

Correctly attached:
E. W. W. Griffin.
Ass.t Draughtsman, Pat. Office.

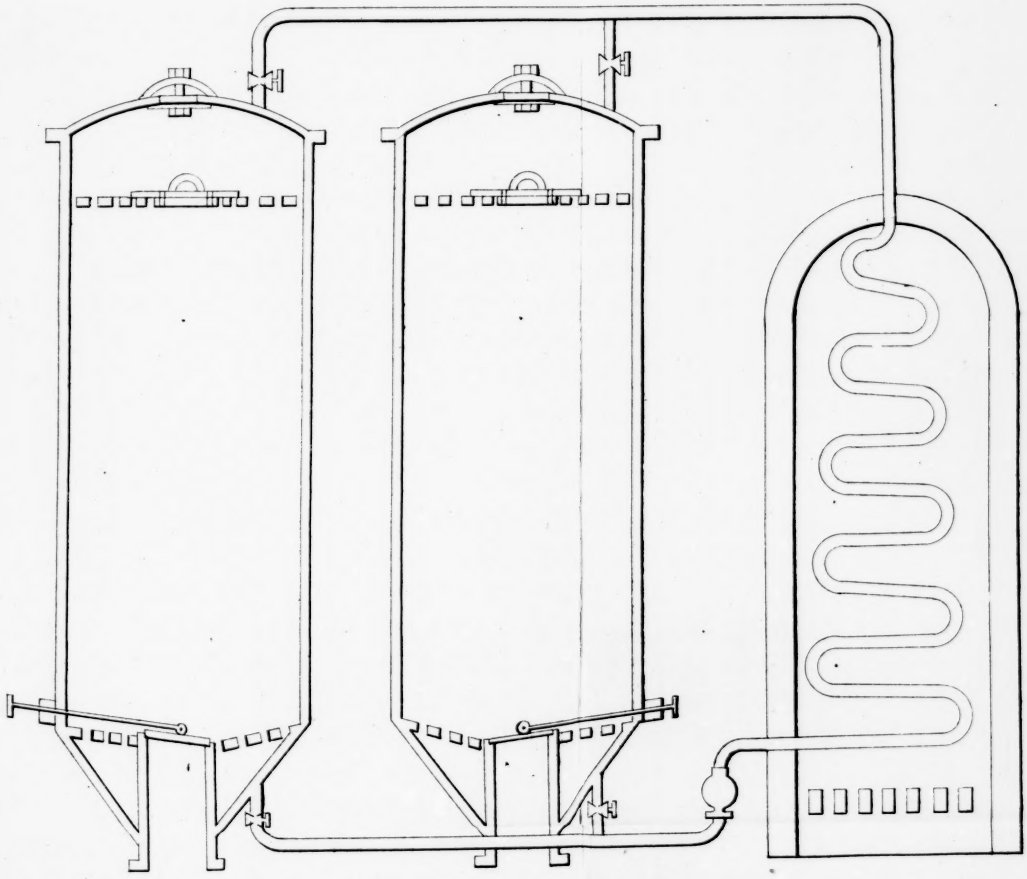
Witnesses.
A. B. Stoughton.
Haver: Fendrich.

Morris L. Keen.

JOHN W. DIXON'S

(OF PHILADELPHIA)

New process for making Paper.



154 { The American Wood Paper Co. vs. Jacob D. Heft } page 120.

IX*

G. Spafford's Boilers and washer of Rags for manufacturing Paper

Reissued June 11. 1850

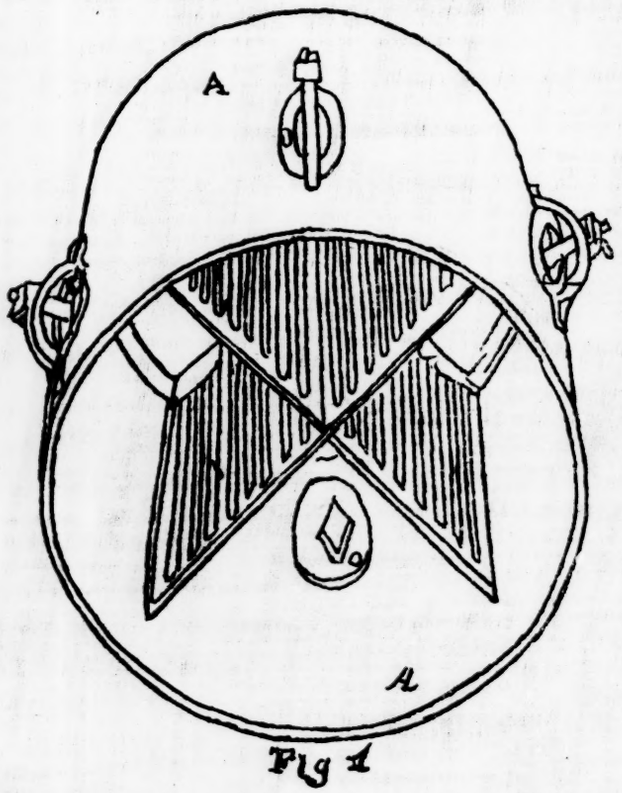


Fig 1

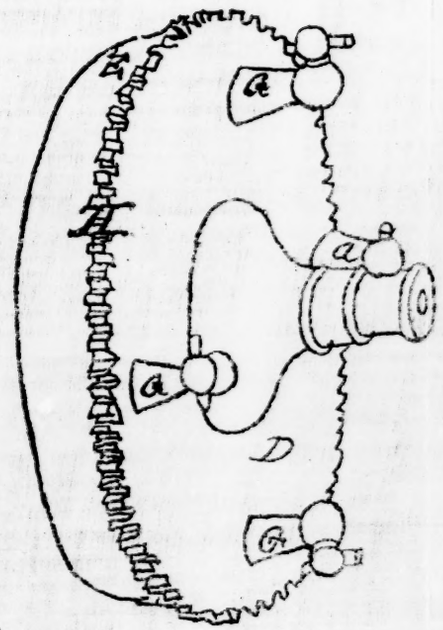


Fig 2.

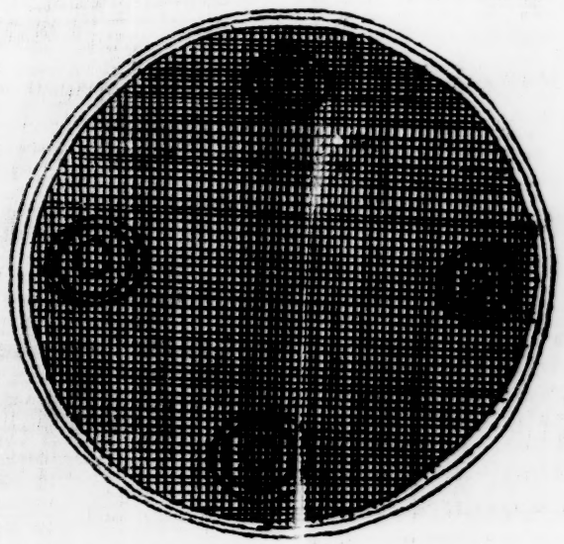


Fig 3

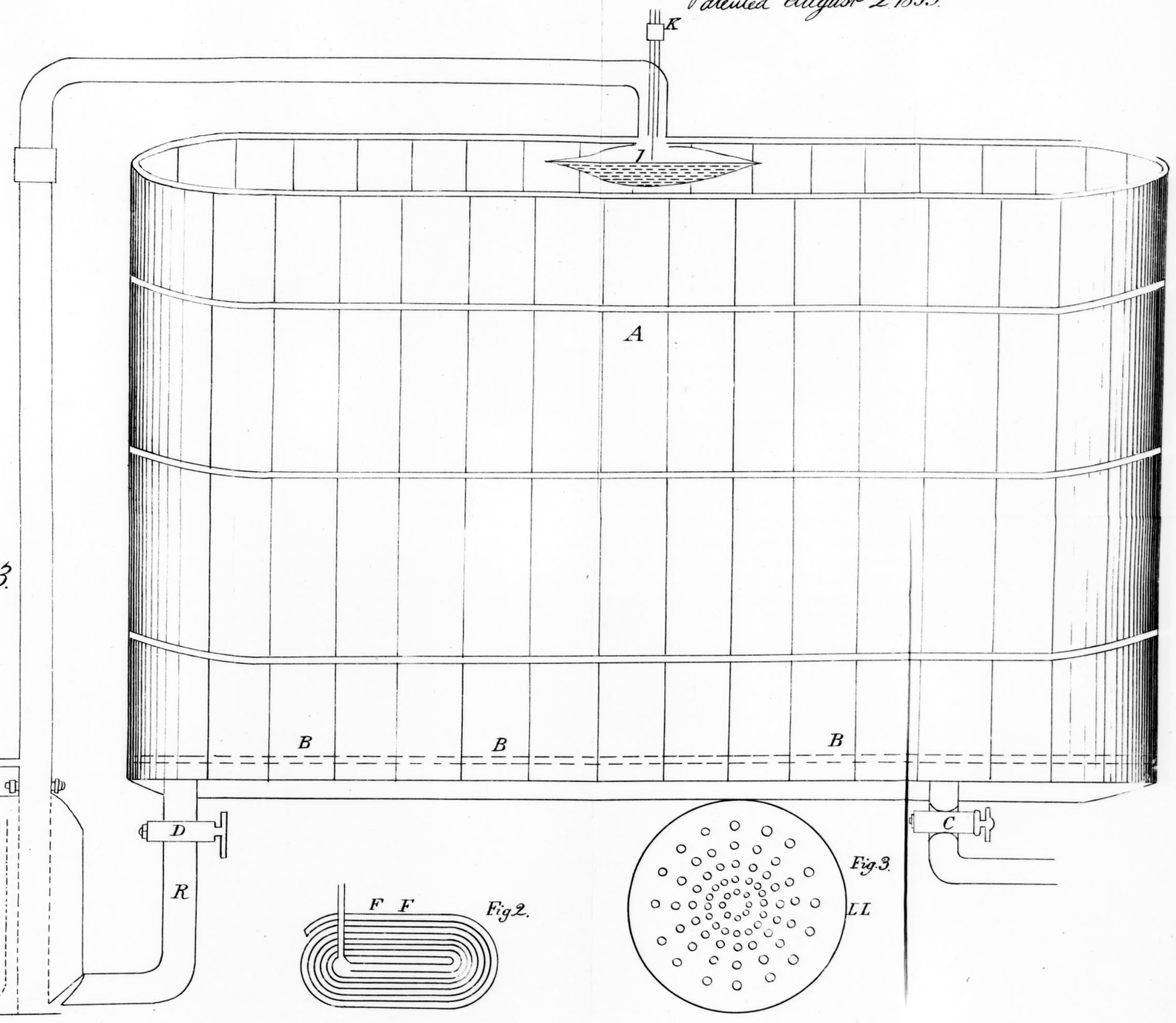
154 { The American Wood paper Co page 893
Jacob D Hyde

5

Coupier & Mellier

Process for making paper pulp

Patented August 2 1853.



154 { American Wood paper Co vs. Jacob D. Cleft } page 433.

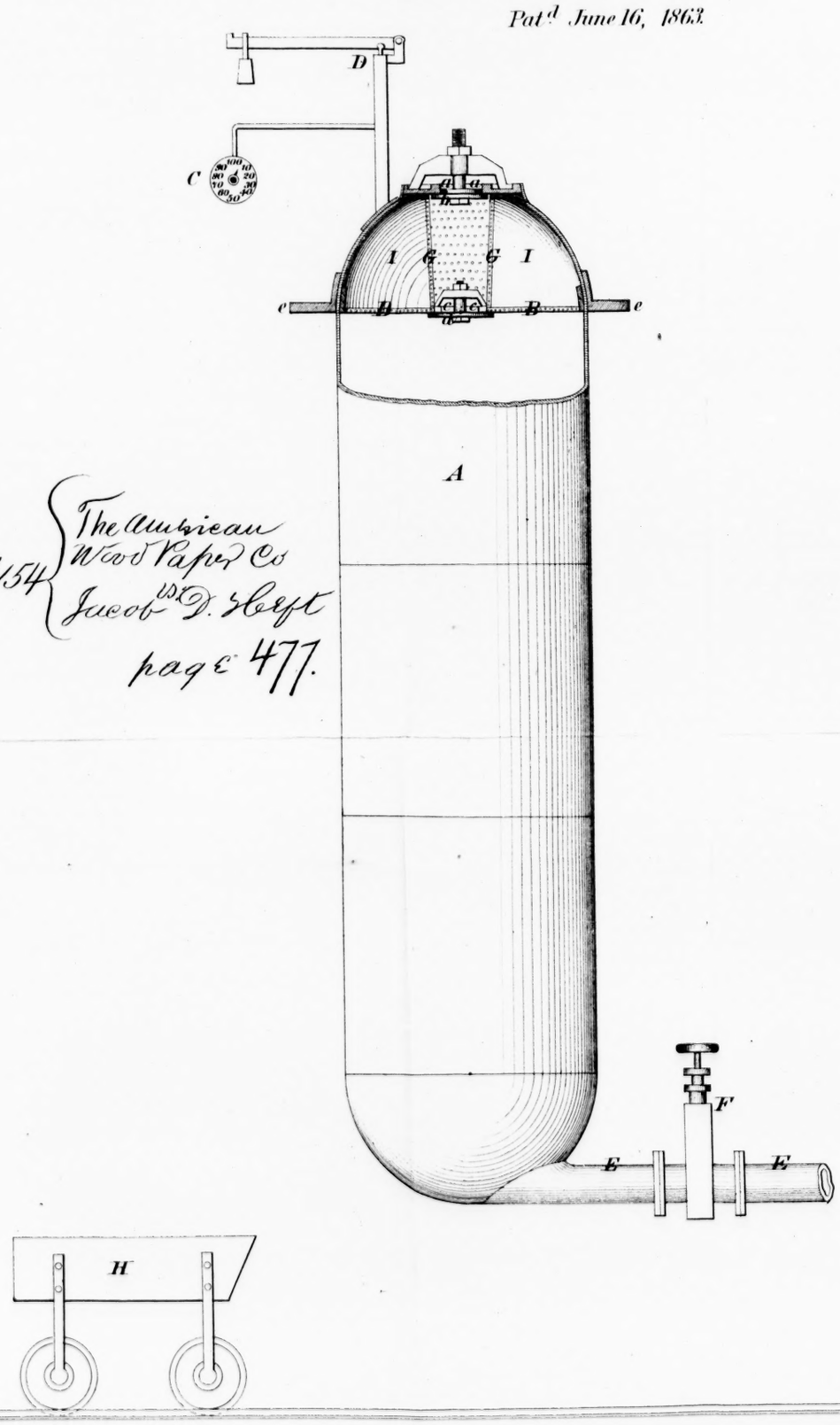
6

No. 38,901.

Morris L. Keen's

Improvement in Boilers, for boiling paper pulp, and other material.

Pat.d June 16, 1863.



No. 154 { The American Wood Paper Co Jacob vs. D. Heft page 477.

Correctly attached:
E. W. W. Griffin.
Ass.t Draughtsman, Pat. Office.

Witnesses:
A. B. Stoughton.
Haver: Fendrich.

Morris L. Keen.

... of Paper-Pulp from Straw.

Patented May 18, 1858.

Fig. 2.

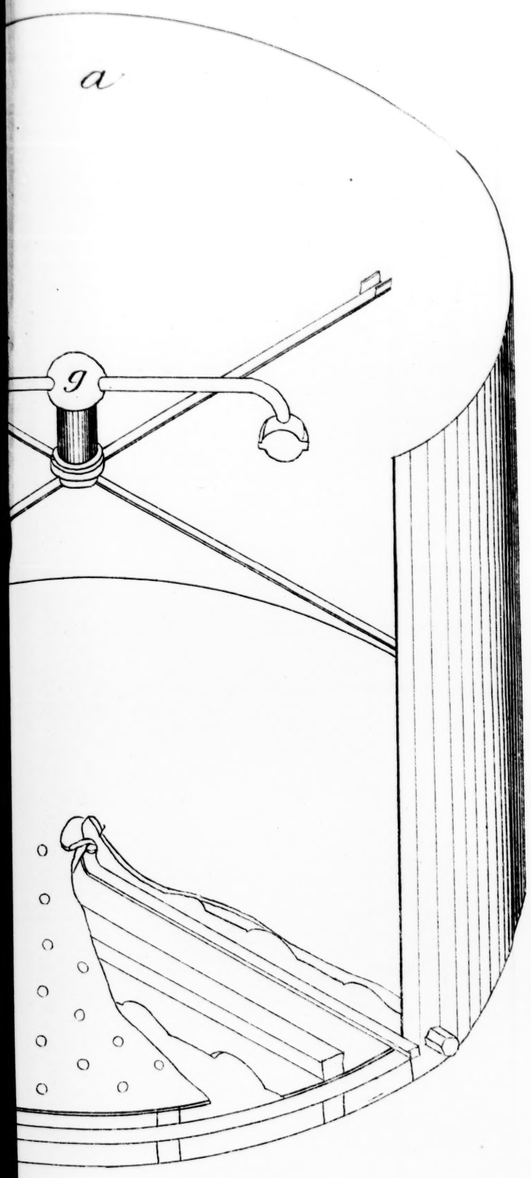


Fig. 6.

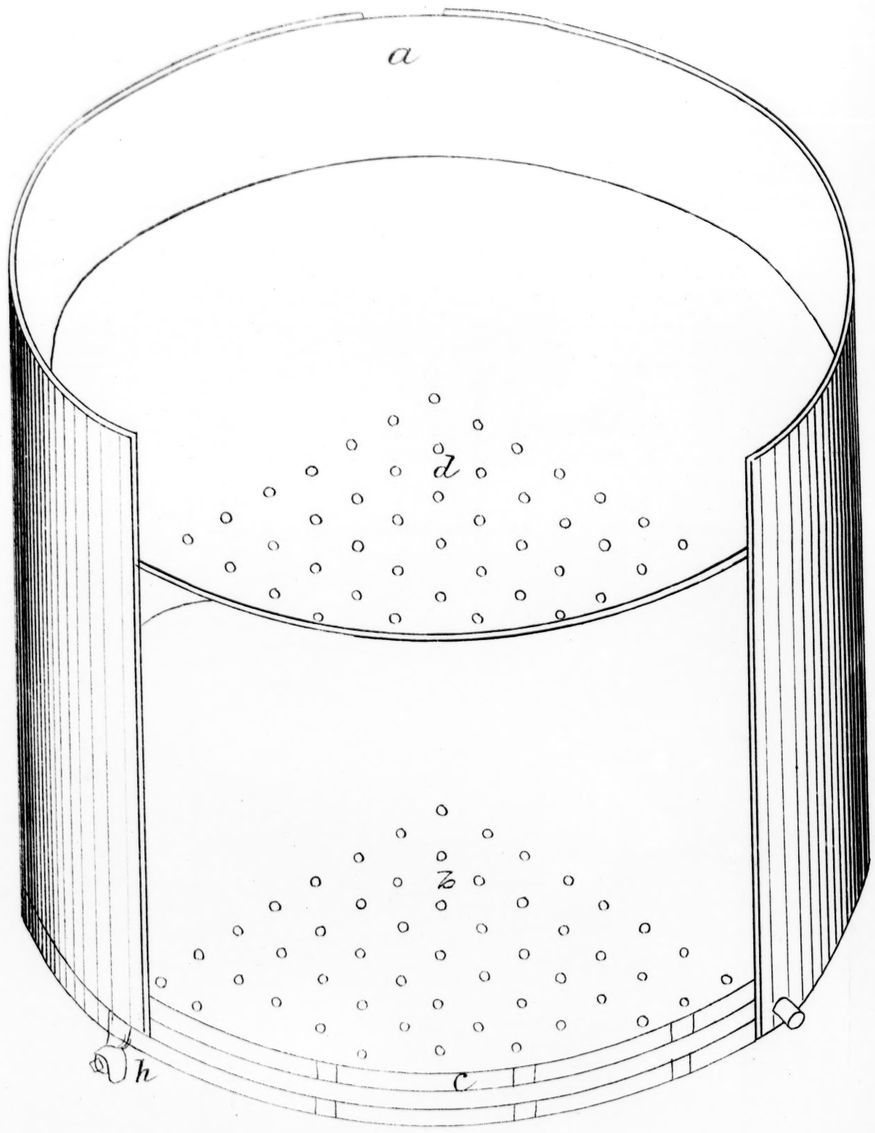


Fig. 5.

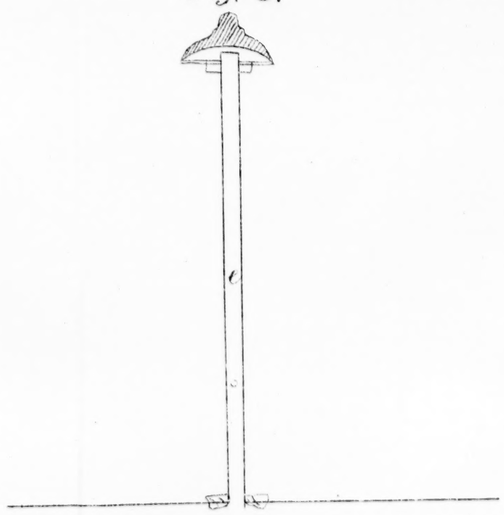
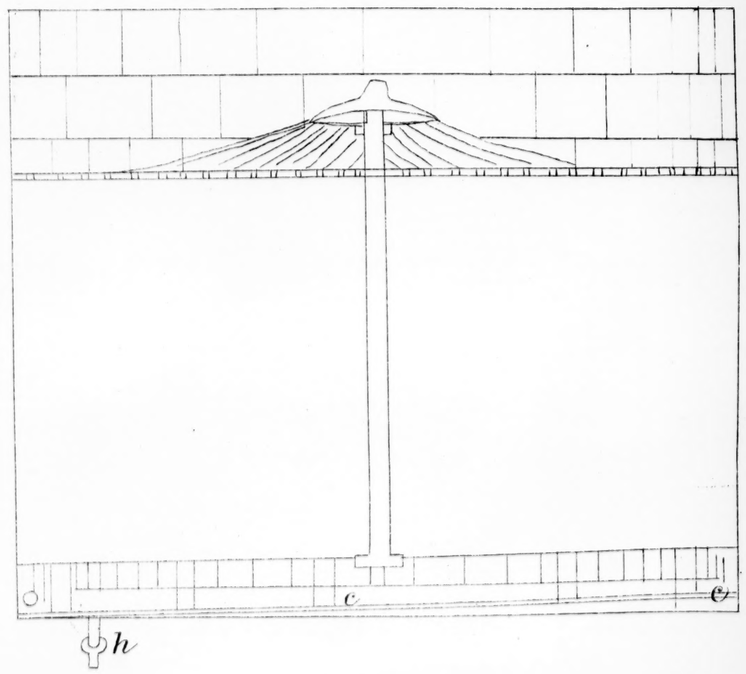


Fig. 3.



M. Nixon — Manufacture of Paper

No 20.294

Fig. 1.

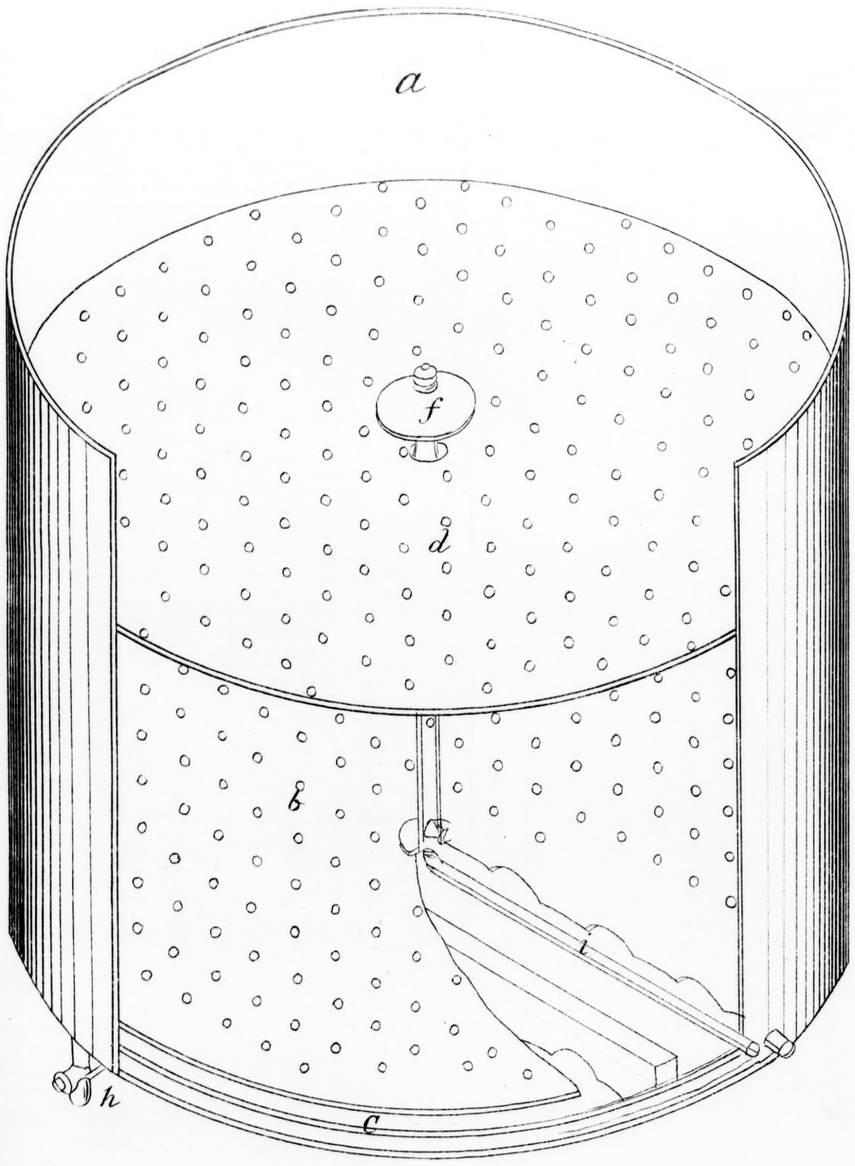


Fig. 2

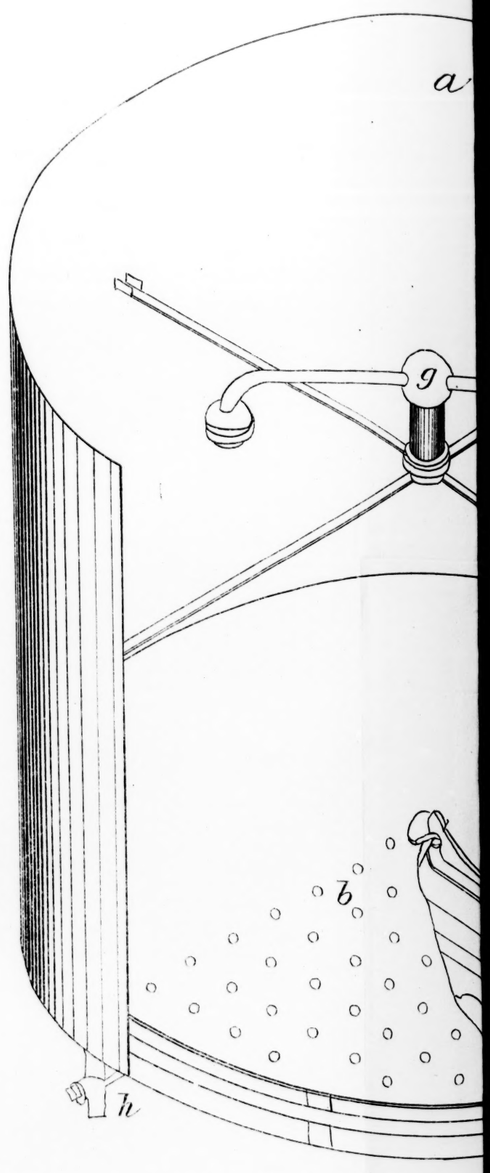
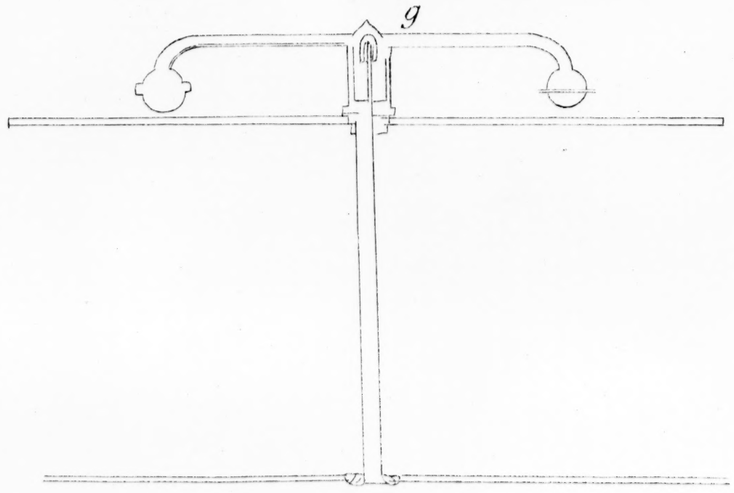


Fig. 4.



No 154 { The American Wood paper Co page 478 Jacob D Stoft No 1

No. 25,418.

Morris L. Keen's

Improved Boiler, for boiling Paper Pulp under Pressure

Pat.d Sept.r 13, 1859.

Fig. 1.

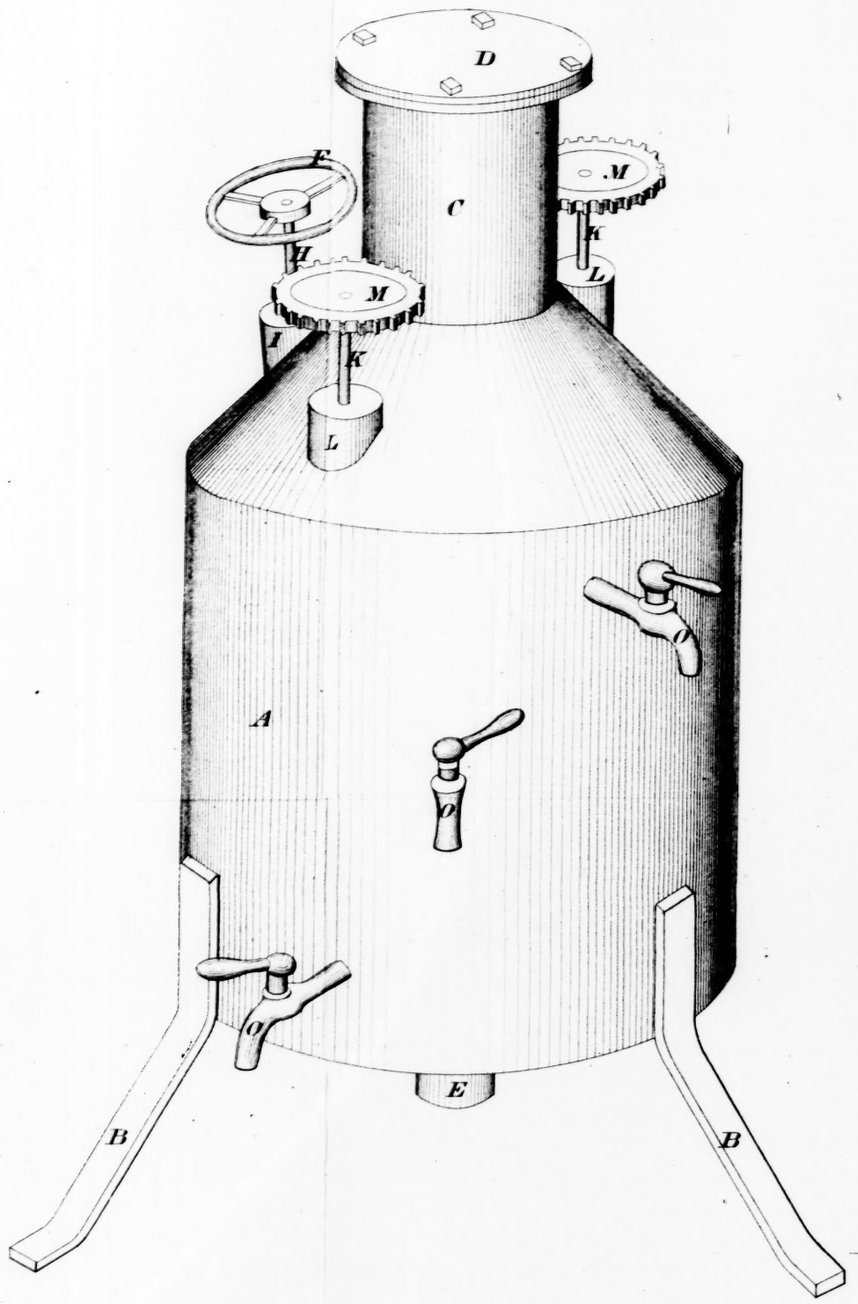
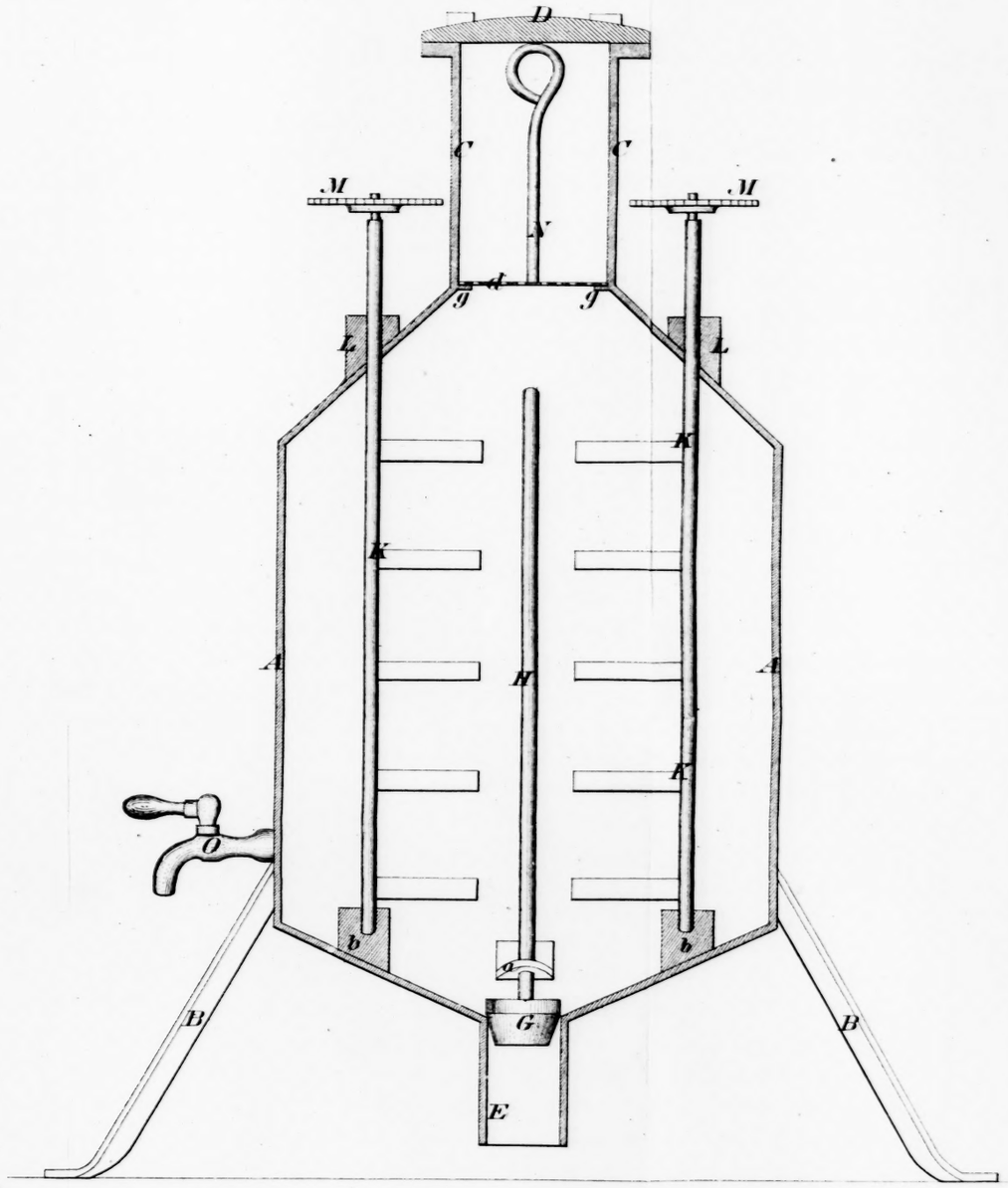


Fig. 2.



Correctly attached

Arthur L. Mc Intire. Drf. P. Off.

Witnesses:

Ephraim Miller.

Hugh Burgess.

Morris L. Keen.

No. 154 { The American Wood Paper Co. vs. Jacob D. Heft. page 478 No. 2.